The Journal of Traumatic Surgery and Occupational Diseases

Industrial Medicine

for

Physicians and Surgeons in Industry

Volume 5 APRIL, 1936 Number 4

THIS ISSUE

Occupational Disease Compensation
—Data Indicative of Cost, for Occupational Diseases in General, and of Silicosis, Asbestosis and Dust Diseases in Particular—

Intravenous Fluids
—Practical Considerations in Shock, Dehydration, Starvation, Etc.—

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—Its Use in Cases of Hemolytic Streptococcus Infection—

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Comparison of the
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The Pneumonokonioses (Silicosis)

Bibliography *and* Laws Book No. 1

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--- from 1556 to December 31, 1933 ---

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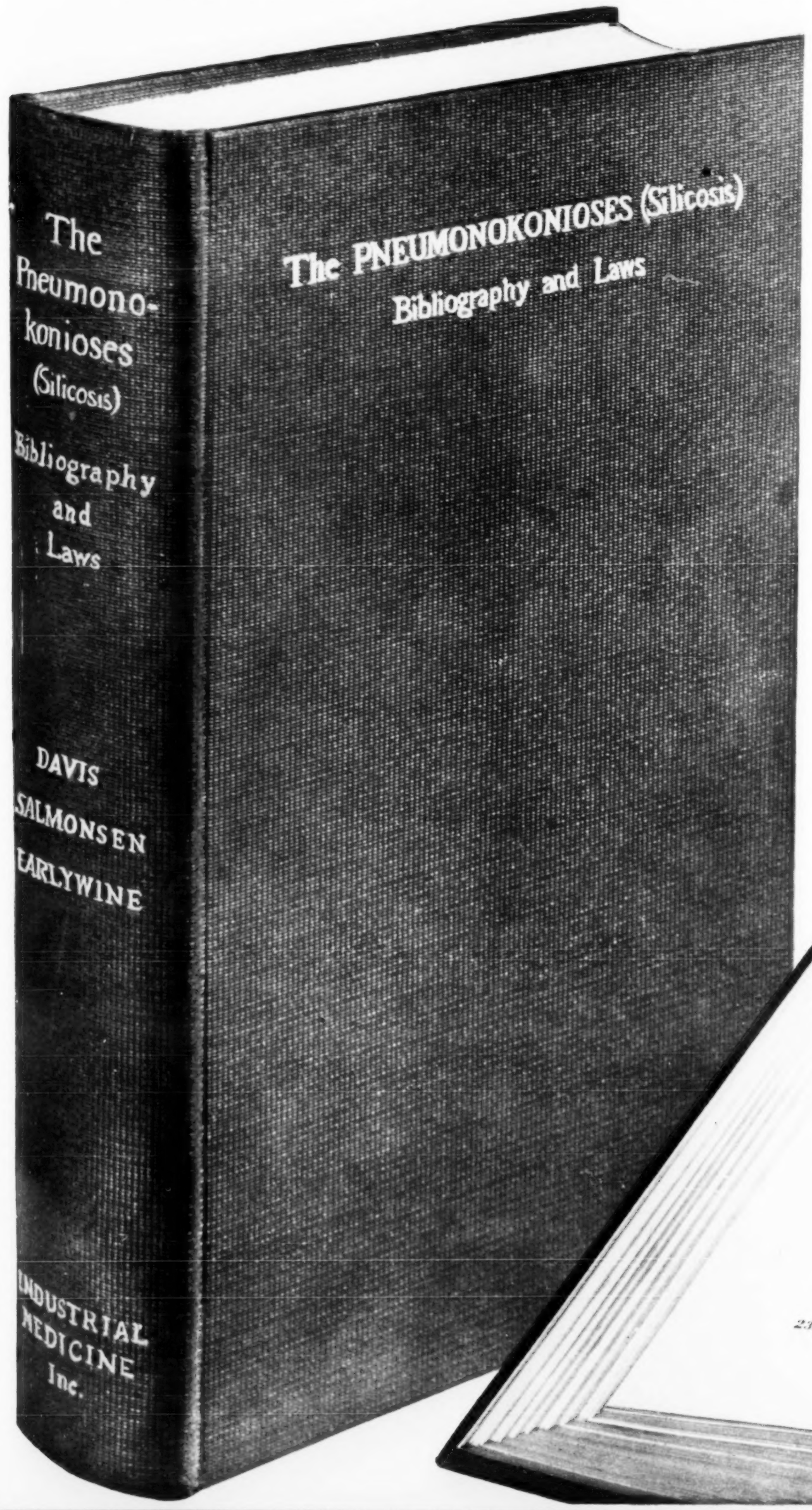

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Joseph L. Earlywine, Attorney at Law, Chicago. Both Dr. Davis and Mr. Earlywine are well known throughout the middle west from years of honorable medicolegal service.

Ella M. Salmonsen, Medical Reference Librarian at The John Crerar Library, Chicago. Physicians and students of medicine have been familiar with her efficiency at the library for many years.

Contents: Sec. I—Bibliographical References 1556-1933; followed by Subject Index, Author's Index, Index of Reference Group Headings, and Reference Index. Sec. II—Laws of the States—Leading Cases.

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This magazine is published to promote sound thought upon and concerning industrial medicine and traumatic surgery. To that end it will contain articles, news items, reports, digests and other presentations, together with editors' comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited.

Industrial Medicine

Reg. U. S. Pat. Off.

The editors will exercise care in checking on the accuracy of data printed, but in all other respects articles and opinions of which expression is allowed are the opinions of their authors—the editors reserving in all cases the right to comment on the same, in the current or any subsequent issues, as they may be inclined.

The Journal of Traumatic Surgery and Occupational Diseases

The Law, the Science and the Economics of Industrial Health

Volume 5 APRIL, 1936 Number 4

Industrial Medicine and Surgery

Abstracts of the Proceedings of the Meeting of the Chicago Society of Industrial Medicine and Surgery, March 25, 1936—

A MEETING of the Chicago Society of Industrial Medicine and Surgery was held Wednesday, March 25, 1936, in the West Room, Medical and Dental Arts Club, 185 N. Wabash Ave., Chicago, at 8:30 p. m., Dr. John G. Frost, President, presiding.

As a preliminary to the regular program as scheduled, Dr. G. Henry Mundt appeared, representing the Chicago Ophthalmological Society, and in a brief informal talk outlined the difficulties confronting the ophthalmologists in this state. A plea was made for practitioners of medicine to recognize the special training, experience and capacity of ophthalmologists and to send their problems to the ophthalmologists for special consideration. The optometrists and ophthalmologists have very different jobs to do. The ophthalmologist is a real medical specialist and is recognized as such. The problem is probably a great deal more serious than many medical men realize, and attention should be concentrated on the difficulties which have arisen in the past, in order to avoid greater trouble in the future. This subject was made the basis for an editorial in the March 14th, 1935, *Journal of The American Medical Association,* comments being made because of the observation of literature recently developed by the Public Relations Committee of the Illinois State Society of Optometrists. The fundamental differences relate especially to the recognition of eye diseases, which is specifically the field of the trained medical man in ophthalmology. It was stated in this editorial that if official organizations endeavored to expand the services of optometrists beyond the limits of optometric training, falsely inducing the public regarding competence and qualifications, a situation must develop in which organized medicine will have to take definite action. Dr. Mundt concluded by asking all of the members of the Society to keep these things in mind and to spread the message to other medical men.

The scheduled program was given as follows: "Endocrinology in Industrial Medicine," by Dr. James H. Hutton — discussed by Dr. Hugo R. Rony; "Surgery of Arthritis" by Dr. Philip H. Kreuscher—discussion by Dr. Daniel H. Levinthal; and "Changes Confronting Modern Medicine" by Dr. Rosco G. Leland—discussed by Dr. James A. Valentine.

DR. HUTTON stated that there were a great many reasons or indications for an endocrine survey — when the diagnosis is uncertain, when there are menstrual difficulties, when there are mental problems, when there is a disturbance of the thyroid, and for other reasons, as he illustrated on outlines given on lantern slides. The diagnostic procedures include an x-ray of the sella, an x-ray to show if there is any decalcification of bone; plotting of the visual fields; Malinger's test; an insulin test; various blood tests, including estimation of sugar, urea, calcium, cholesterol; urine tests, including amount, nitrogen, sugar; a glucose tolerance test; a basal metabolism rate with a discussion of its significance, and vital capacity. The diagnosis in these cases may be based at times on exclusion; the history is very important, especially the height and weight, the occurrence of various infections, particularly mumps, measles, and typhoid fever; the menstrual history is likewise important, as are operations, injuries, and pregnancies. In the physical findings the stature and proportions are of considerable moment, and the type of obesity regarding the location and acquisition of fat is to be seriously considered. A survey of the skin and appendages is also not to be excluded. In using x-ray therapy in various endocrine cases of those which had essential hypertension, 121 were improved, 37 were unimproved, and 21 could not be followed sufficiently. In experience with diabetes and hypertension associated in this series, eight cases were encountered where both were improved, eight cases where the hypertension was improved, four cases where the diabetes was improved, and five cases where there was insufficient treatment given to come to any conclusion. In the doing of 82 glucose tolerance tests, there were 52 of the diabetic type of which 33 were improved, and 30 of the non-diabetic type of which 19 were improved. In using x-ray therapeutically for

pituitary and adrenal dysfunction, a very small dose is now employed which is about one-ninth of the so-called "erythema" dose. A number of case reports were given on the x-ray therapy of hypertension, describing the various details. It is understood that in this group of cases and in the work now being done, this form of therapy is applied to what is known as essential hypertension only.

Dr. Rony, in discussing Dr. Hutton's presentation, was particularly impressed with the importance of the fatigue syndrome that he has seen, especially with its relationship to endocrinology. First, there is the toxic type of fatigue in which one should look for focal infection, but this has been very much exaggerated. Second, there is the psychogenic type which is the most common and in which one may find or expect to find many kinds of mental conflicts. In these persons exercise and activity are of greater value than rest. In the third or endocrine type of fatigue, the pituitary, thyroid or adrenal may be affected alone or in combination—in fact, these difficulties are usually accompanied by fatigue. It should be remembered that the differential diagnosis in these conditions is not easy.

Dr. Frost, the President of the Society, in discussing subjects as presented by Dr. Hutton and discussed by Dr. Rony, cited several case histories from his own experience.

DR. KREUSCHER, in presenting the subject of "Surgery of Arthritis," stated that there is no condition which has caused so much incapacity and loss of time and is with us so much of the time as arthritis. The surgical treatment of arthritis consists in removing the cause of arthritis or the focus, in relieving pain, in the prevention and correction of deformity, and in intravenous medication. The operations involve exploratory types, synovial resections, arthrodeses and arthroplasties. Dr. Kreuscher is of the opinion that a great deal more surgery is needed in the successful treatment of arthritis. There are other aids, such as vaccines, the injection of foreign proteins, intravenous medication, and fever therapy. The essayist was of the opinion that discussions should be restricted to a simple classification of arthritis consisting of atrophic and hypertrophic, and that there is a place for surgery in both types. Of the foci of infection which are most frequently involved, mention was made of tonsils, teeth, and sinuses, which compose 60% of the foci of infection in the series presented by the speaker. One must also consider Neisser infections. Cases were demonstrated by lantern slides, showing instances of arthritis deformans, joint mice in a number of cases, and some instances of fusion of the elbow. An enlargement of the synovial membrane may be effected by the injection of fluid which is visible in the x-ray and this has been found to be a useful procedure. The author makes use of bloodless operations and long incisions. A common finding in operation is hypertrophy of the synovial membranes. In many operations the true condition of the synovial membranes may not be recognized until adhesions occur. Other cases were demonstrated by lantern slides, including one of osteoarthritis dessicans, of thrombi in different portions of various joints, of Still's disease, and of Neisserian infection. Fixation is important in chronic arthritis, rather than allowing indefinite disability. It is important to assist nature to ankylose the joint in a good position. Finally, the increased use and better adaptation of surgery to problems of arthritis offers a great deal of assistance in decreasing disability.

Dr. Levinthal, in discussing Dr. Kreuscher's paper, stated that surgical procedures in arthritis are now a great deal more conservative than formerly. Synovectomies show a great incidence of tuberculosis. Dr. Levinthal doubts the value of sympathectomy or cordotomy. Different types of surgical procedures were discussed and illustrated by lantern slides showing the various procedures.

Dr. Frost, in commenting on the subject, stated that on certain railroads the backs of all employees are x-rayed and in many instances show pathological findings, although the subjects are free of symptoms.

DR. LELAND, in speaking on "Changes Confronting Modern Medicine," stated that this very meeting was an excellent example of the difference between the attitudes and the practices of medical men in this and other countries. There are certain charges made by the proponents of changes in medical practice—the 50% quoted as not having adequate medical care is not in accordance with the figures, which show that approximately 95% has been accounted for as receiving proper medical care in groups where real statistics are now available. The claim that medical practice is not as efficient and remunerative in this country as in other systems has not been able to be substantiated. Another claim which is made by the proponents of changes in medical practice is that patients do not fare as well under our present system as in others—in examining the figures we find that workers in this country lose from eight to 13 days per year on account of sickness, while in other countries the figures show a loss of 15 to 30 days per year per employee. Certainly we have to admit that the standards of medical practice in this country have advanced without legal compulsion, that much progress has been made and that life expectancy has been greatly increased. One feels that the situation shows that a system of independent medical care has been compared with one in which political influence will be a great factor. When we compare the rates for tuberculosis, we discover that there has been a more rapid decrease, and that the rates are lower in the United States than in any country where state-managed medicine has been practiced.

Certain points will surely have to be recognized—there is an uneven distribution of physicians, which is principally caused by the variation in the amount of money, the population, the type of industry, and other things; there have been many abuses of hospitals and clinics, and an attempt has been made to correct these; there have been unfair practices in workmen's compensation administration, but the medical profession has been steadily using its influence and improving these situations. There are two outstanding points that deserve special study: the first being the management of certain types of medical service in industry—if all groups, such as teachers, ministers, and others, were to be given the kind of service that industrial employees are advised

to have by certain proponents of changes, it would produce a very confusing and difficult situation, in reference to the private practitioner of medicine. The second point deserving of considerable study is the university and college health services in various parts of the country—it seems important that the large number of university and college students in this country should be taught the proper pattern of medical service to seek in the future, that this should form a part of the educational process—unfortunately, however, many, too many in fact, have become dependent upon the type of medical service which has been offered to them in the various universities and colleges. Properly used, industrial medical service can place men in industry intelligently, cut down absenteeism due to sickness, and show other advantageous results. Work in occupational diseases deserves special training and background. It seems highly significant that the well-trained industrial medical man should be as much a specialist as medical men in other special lines. Reference was also made to the study of the American Medical Association and the recommendations given in the brochure entitled "Medical Relations under Workmen's Compensation." The essayist could see a great deal of improvement in relationships in some states, but there is still much room for greater improvement; in accident prevention there should be greater consideration of the human side, and time reductions due to accident losses should be carefully watched—the physician should be a more prominent figure in this work. Although there are medical service plans now in operation in 200 different societies in the United States, these are not a substitute for the regular practice of medicine which if properly given would obviate such plans. In conclusion, we must recognize that the profession must advance scientifically; good care must be given; practice by institutions should be eliminated; good service should be supplied at prices adjusted to present economic conditions; preventive medicine should receive greater emphasis and should be practiced along with curative medicine; the profession itself should make special studies of the social, legislative, economic and ethical affairs, and should be in a position to exercise intelligent control; oncoming generations should be prepared with a better understanding of what real medical service is and how to obtain it; the principles of ethics should be studied anew and properly applied; and medicine should be recognized as the permanent institution which it is.

DR. VALENTINE, in discussing Dr. Leland's presentation, said that some collectivism should be expected in the medical profession, but later on, with better conditions, other changes might occur. One great difficulty is the proper allocation of work belonging rightfully to physicians, and as instances of this, the distasteful experiences with anesthesia, x-ray and clinical laboratory work were cited. Comparison was drawn between the free work done by physicians and the lack of such free work done by laymen in various professional pursuits.

The important thing to keep in mind is that the medical profession must agree very definitely on what the fundamentals of these problems are and then put them into effect.

Pooled Convalescent Serum

Its Use in Cases of Hemolytic Streptococcus Infection

By E. C. HOLMBLAD, M.D., F.A.C.S.,
and
R. A. JACOBSEN, M.D.,
Chicago

EVERY once in a while there come into the experience of every surgeon certain types of fulminating streptococcic infections. It does not seem to matter as to whether these infections arise through acute infectious diseases, such as scarlet fever, wound infections of the feet or heels, throat infections with cervical adenitis, or any other portal of entry. Even though such cases are given prompt and extensive treatment, it seems that the patient's powers of defense are inadequate, and that, regardless of the type of treatment, the infections progress, becoming generalized, associated with extensive complications, and the patients die by onset of general sepsis. Many of these fulminating infections are of the streptococcus type, and when such infections are cultured they are found to be frequently of the hemolytic streptococcus variety. It seems that these types of infection prevent proper localization, or abscess formation, and form serious states of toxicity, rather than pus formation. They are usually rapid in onset and associated with lymphangitis, lymphadenitis, high fever, rapid progression, and rapid toxicity.

During the past year we have had experience with two of such virulent infections, and a third case that did not quite reach the hopeless state. In the two serious cases, when the relatives had been notified that nothing further could be done, and that whole blood transfusions were being considered, we came in contact with the work of the Samuel Deutsch Convalescent Serum Center at the Michael Reese Hospital, Chicago. After discussions of our problem with Dr. Levinson, we used pooled convalescent scarlet fever serum in the treatment of these cases, with most gratifying results. May I refer to two articles recently published, bearing on the use of convalescent scarlet fever serum?*

The use of convalescent scarlet fever serum in the treatment of definitely known cases of scarlet fever has been had for a considerable length of time with the best of results. We find that many patients carry hemolytic streptococci in their throats, and that many streptococcic infections, such as running ears, cellulitis, cervical adenitis, on culture are shown to be caused by hemolytic streptococci. There is sufficient similarity in the organisms found in such infections to the organisms producing scarlet fever to assume certain common characteristics, and possibly even certain common and similar immunologic reactions. It has been observed that strains of streptococci vary in different localities and in various types of infections, selecting certain organs at times, and associated with a group of symptoms quite similar in character. The treatment suggested is based on the assumption that immune quali-

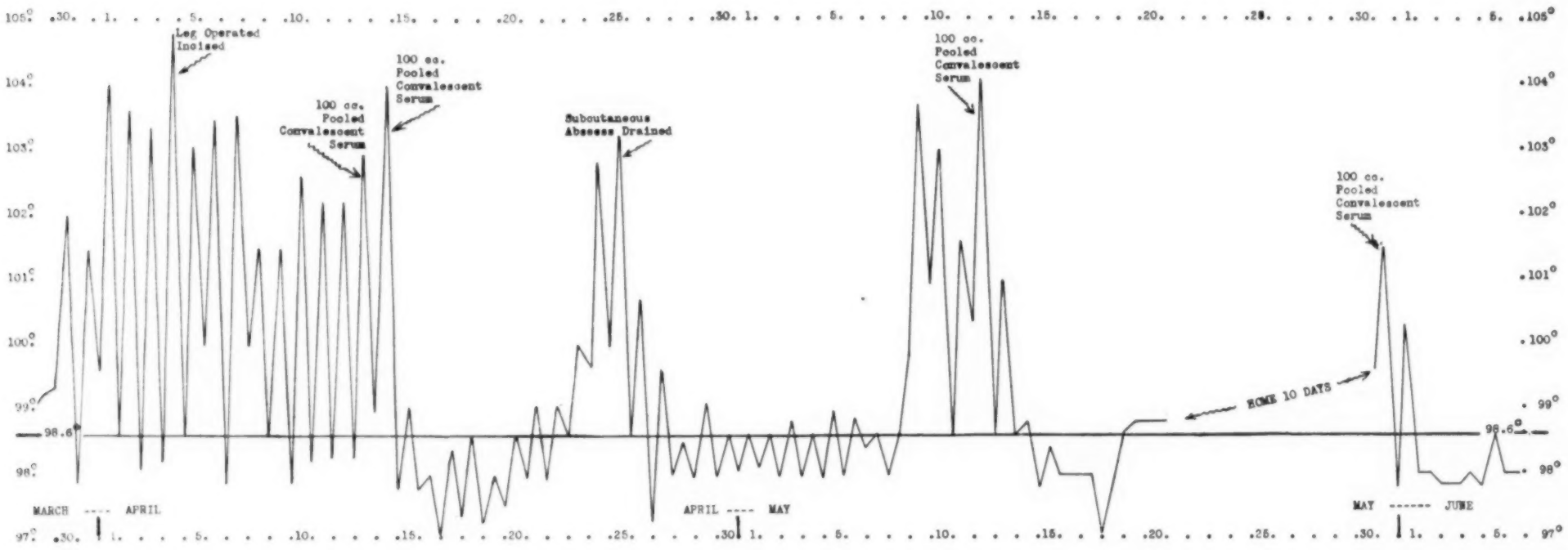
*DRS. HOYNE, LEVINSON and THALHIMER, in *J.A.M.A.*, Vol. 105, pp. 783-789, September 7, 1935; and
"Pooled Convalescent Scarlet Fever Serum Treatment of Diverse Streptococcic Infections," in *J.A.M.A.*, Vol. 105, pp. 864-866, September 14, 1935.

ties found in the blood serum of human beings recovering from scarlet fever may have very definite value and can be used for transmitting passive immunity.

In the preparation of this pooled serum, blood is obtained from 25 or 30 convalescent scarlet fever patients. Approximately 225 cc. of blood are drawn, yielding approximately 100 cc. of serum, All of the serum obtained from the 25 or 30 patients is then mixed together so as to form a uniform and balanced serum, representing the serum and its associated immune bodies from each of the 25 or 30 convalescent scarlet fever patients. You can readily see that this is an effort to obtain immunity from a multiplicity of hemolytic streptococcus strains. This serum is then prepared under a government license and so as to be entirely free from serious blood stream infections, such as syphilis or malaria. The serum is then put up in sterile vials of 20 cc. quantities. I have only time to mention some of the high points observed in the use of this serum. It should be remembered that this is all human blood serum, and that so far no anaphylactic reactions have been observed. The serum may be given intravenously or intramuscularly. We have chosen to give it intravenously, because in these cases heroic treatment is demanded, and quick action and the full benefit of the serum desired. We find it advantageous to give this serum slowly, taking 20 to 30 minutes to give 100 cc. The average case requires from 100 cc. to 200 cc., preferably given on succeeding days. This volume of passive immunity has been found to last from 18 to 25 days, at which time it may be necessary to repeat at least 100 cc. in case the patient's own immunologic reactions and defense are not adequate. One must be on the alert for localizing infections, such as abscess formation, chest complications, or other plausible explanations for again developing a rise in temperature. These conditions must be treated as indicated. We are, indeed, very gratified with our experience in the use of this serum in the three cases where we have used it personally.

I have prepared a chart representing the maximum and minimum temperatures recorded per 24 hours in the two serious cases.

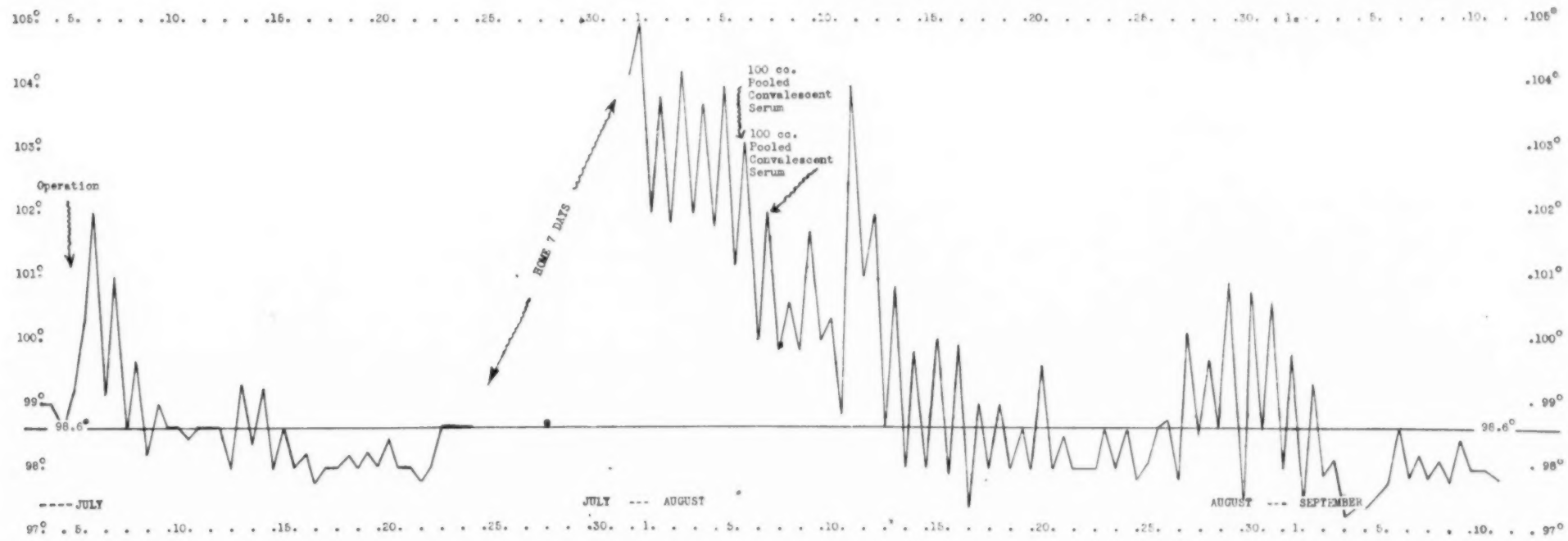
CASE 1: Mrs. E. S. is a widow, 65 years of age, whose occupation is that of a cook. Her previous medical history reveals that years ago she had a thyroidectomy, two uterine suspensions, and several years ago a hysterectomy. She gives a history of having had scarlet fever during her early youth. The remainder of her past medical and family history is essentially negative. She has had extensive varicose veins, and on March 21, 1935, she applied liniment to these varicose veins and wrapped up her limbs with bandages. Blisters formed, which became infected on the second day, and on March 27, 1935, she noticed a marked increase in her pain and swelling of her legs, especially the right, with pain extending up the thighs and terminating in swollen, painful lumps in the right groin. We first saw her on March 29, 1935, at which time examination revealed infected blisters in the right popliteal space, with a temperature of 101°, lymphangitis and marked lymphadenitis in the right inguinal region. The leg became more painful, even though she was immediately hospitalized, on March 29, 1935. She was put to bed and her right leg was elevated and treated by voluminous, hot, wet fomentations from the toes to her thigh and changed every hour, day and night. In addition, she was given moderate cathartics, forced fluid and analgesic medication. Her temperature continued to rise. The infection in the leg became more extensive. On April 4, 1935, there appeared to be fluctuation on the lateral aspect of the knee, and under ethylene anesthesia this boggy fluctuating area was incised. Cultures were made from the serum obtained, although frank, free pus from an abscess was not found. These cultures were practically pure cultures of hemolytic streptococci. The possibility of erysipelas was considered, and on March 5, 6, 7, and 8, 1935, she was given 10 cc. each day of mixed erysipelas antitoxin and stock streptococcus serum. She did not have a body rash. The infection about the leg was not typical erysipelas by any means. It did not have a line of demarcation. It was not spreading, as cases of erysipelas do, and she did not show a desired response to this treatment. It was on April 13, 1935, at a time when this patient was practically moribund, extremely tox-



Case 1

ic, delirious and in very serious condition that she was given her first 100 cc. of pooled scarlet fever serum. It will be noted from the chart that following the second injection of serum on April 14, 1935, her temperature dropped almost miraculously to a maximum of 99°. The temperature was only one of the indications of a change in this patient's condition. Her relief from toxicity, the subsidence of her delirium, her mental attitude, the fact that her appetite returned, and that her body functions became more normal, were the striking things observed within the first few days after the administration of this serum. The temperature remained low until April 22, 1935, at which time there was a gradual rise to a maximum of 103° on April 25, 1935. On this date a small localized abscess on the side of the leg was opened and drained, and following this her temperature again subsided until May 9, 1935. Steady progress was made from April 25 to May 9, 1935. At this time, approximately three weeks after the giving of the serum, she developed a chill and her passive immunity had apparently been used up. She was watched for two or three days to see if she could handle her infection herself, but on May 12, 1935, she was given 100 cc. of the pooled scarlet fever convalescent serum. This immunity was associated with an immediate response and lasted until June 1, 1935. In the interim, the patient had been at home for 11 days. On June 1, 1935, she was given her last 100 cc. of serum, and since that time she progressed to an uneventful recovery. This patient has had no further illness in the meantime. She has again been able to resume her occupation, and she is alive and active at this time.

at our office. There was definite evidence of early strangulation at the site of his incisional hernia. Under manipulation this strangulation was reduced. The patient's pain eased and the bowel and bladder function returned to normal. Because of this experience he was advised that his incisional hernia should be operated, and accordingly, on July 4, 1935, he went to the hospital. On July 5, 1935, his incarcerated incisional hernia was operated under ethylene anesthesia. The hernial sacs were excised and the remaining layers of fascia were imbricated by mattress sutures with chromic catgut. The patient made an uneventful recovery from this operation and left the hospital on July 24, 1935, having been fever free for over 10 days. There was no infection at the site of operation, and the wound was closing by primary union. The patient remained at home, with steady improvement, until August 1, 1935. At this time he developed a sore throat, associated with chills and a high fever. He was immediately hospitalized and cultures from his throat revealed the presence of hemolytic streptococci. His throat and tongue were markedly injected, as were also his conjunctivae and nasal mucous membrane. He did not have a rash, and the appearance of the operative wound on August 1, 1935, was of such character as to be entirely inadequate to account for this infection. This patient became rapidly toxic, delirious, and a diagnosis of hemolytic streptococcus infection seemed justified. With the persistence of toxicity and his general condition becoming worse, on August 6, 1935, he was given 100 cc. of pooled convalescent scarlet fever serum, and another 100 cc. intravenously on August 7, 1935. His temperature subsided moderately, ex-



Case 2

CASE 2: Mr. H. L. is a young, robust man, 26 years of age, who is an attorney, and gives the following history. He had an appendectomy in 1920, at which time three drainage tubes were placed in the incision, and he was told that the wound was not sutured. Following the subsidence of the drainage he wore a binder for a considerable time, and he then became interested in athletics. In 1928, while being examined for life insurance, he was informed of the fact that he had a small incisional hernia at the site of his appendectomy operation. This mass gradually increased in size and became as large as both of his fists. He paid little attention to it, and about the middle of June, 1935, he developed an acute, severe, colic-like pain in the abdomen, for which he presented himself

cept for a few days when chest findings accounted for an increased temperature. Subsequent to August 13, 1935, his temperature did not exceed 100°. His general condition improved. The abdominal wound showed evidence of localization of infection, and he progressed to steady improvement. About August 27 or 28, he had a slight chill, suggesting that his passive immunity was about used up, and we were then on the lookout for the possibility of giving him additional serum if it became necessary. During the subsequent days his general condition, his temperature, and other findings indicated that the patient's own power of defense was adequate to control the situation. He left the hospital on September 22, 1935, having been free from a temperature above 100° since August 31,

1935. After an additional four to five weeks of convalescence he resumed work and has been working steadily since then, without loss of time. It is true that in this case a blood culture of hemolytic streptococcus was not obtained, but these hemolytic streptococci were definitely obtained in cultures from his throat, and a week later in cultures from his abdominal wound.

In our experience with these two seemingly hopeless cases we feel that the pooled convalescent scarlet fever serum has definitely been a life-saving agent, in giving us passive immunity for a period of approximately three weeks, or until such time as the patient's physical condition could control his infection.

Identification of Radiograms

By ARTHUR R. METZ, M.D., F.A.C.S.,
Chief Surgeon,
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DURING 1935 we instituted the plan of reviewing all x-ray films made of injured employees, the object of this being so that we may better understand the extent of injury, and also to be in a position the better to advise the Claim and Legal Departments as to the seriousness of the accident.* It also gives the Chief Surgeon's Office a better opportunity to cooperate with the local surgeons in managing some of the more difficult problems.

As the result of reviewing a large number of films from various sources, we have observed that some are well labeled while others have no marks of identification whatever photographed on the film.

It is important in industrial work that all x-ray films should be properly labeled by having photographed on the emulsion certain definite marks of identification which include the following information:

1. Date of exposure.
2. Number or name of patient.
3. Letter R or L, designating side.
4. Name of hospital or x-ray laboratory.

The form and placement of these marks of identification are shown on the following photograph:

These marks of identification should consist of lead numbers and letters which should be placed upon the film in the upper right-hand or left-hand corner so they can be easily read while viewing the film in its normal position.

We also observed that on many films the chemistry or dark-room technique has been bad, so that the films are not good for diagnostic purposes.

We would appreciate very much in the future if our company surgeons and radiologists would pay some special attention to see that films made on railroad cases are properly identified, and the effort be made to get good diagnostic films.

In cases where there are doubtful lesions, it is always well to x-ray corresponding parts together when possible, such as two hands, two feet, or right and left shoulder, etc.

We want to emphasize the importance of proper identification, as at any time films may become of medicolegal value which makes it important for the doctor or laboratory involved to have the necessary marks of identification photographed on the emulsion.

* At a meeting of the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East), at Chicago, November 15, 1935.

Injuries to the Knee

By WILLIAM R. CUBBINS, M.D., F.A.C.S.,
Professor of Surgery,
Northwestern University Medical School;
Surgeon,
Cook County Hospital,
and
JAMES J. CALLAHAN, M.D.,
Chicago

I WANT to talk to you about crucial ligament injuries and their early recognition.* The late recognition and repair of this condition is very difficult and not very satisfactory. We have cases showing beautiful results from our corrective methods, and we have cases in which the results are not so good. It is absurd to think that anything that is as complicated as repair of the crucial ligaments, whether single or double, can be made simple. It cannot be done. We have made it simpler, but far from simple. I am going to show a woman who entered the Cook County Hospital with a compound dislocated knee joint, so completely dislocated that the bone could be dislocated in any direction and yet, with simple immobilization, this woman had a complete restoration of function. She will now walk before you, and I do not believe there is a man in your group who can tell which limb was injured. Dr. Callahan, my associate, debrided it, by one stitch held the edges together and dressed it dry, so that the knee joint could wash out whatever dirt was in it. The knee was immobilized for 120 days. During the first four days the dressing was changed frequently to remove the extravasated material, and to prevent that peculiar fermentation that occurs in extravasated fluid.

When a patient comes to you with an injured knee joint, a very careful examination should be made for excess motion. That excess motion can be due to injury of the condyles of the femur or tibia, and also to a rupture of the crucial ligaments. When the crucial ligaments are ruptured, obviously many other ligaments in the knee joint are torn and destroyed. We have the collateral tibial and fibular ligaments in many cases torn from their attachments to the femur. In two cases the collateral ligament has been torn from

* At a meeting of the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East), at Chicago, November 15, 1935.

the head of the fibula. If these cases are recognized early, not by x-ray, but by clinical examination, and this excess motion is found, immobilization of that injured knee for 120 days will give as satisfactory a result as in this woman who has just walked before you. If you examine this woman's knee you will find she has no more free motion in her right knee, which was the injured knee, than in her left knee, which was not injured.

Some men say that ruptured anterior cruciate ligaments do not cause symptoms. We have had only one case in which an anterior cruciate had been ruptured for a long period before we observed it.

This man most certainly had symptoms, and was improved very materially by a reconstruction of that ligament. This anterior cruciate ligament had been absorbed; there was no trace of it remaining at either point of attachment. This absorption of the ligaments we have also observed in four cases where double cruciate ligament injuries had been diagnosed and an operation made for repair. Just how frequently these ruptured ligaments are absorbed cannot be positively stated.

Obviously, we do not know at what period this absorption takes place, but that it has occurred in five of our cases we have no doubt whatever.

Here is a young man who came in with a beautiful history of ruptured lateral meniscus. We decided to let one of our residents operate upon him because it was such a typical case. When we operated we found an entirely different condition from what we expected. Without anesthetic we were not able to determine any excess motion of this joint. When the patient was anesthetized it was found that the anterior cruciate was ruptured and torn out of the posterior portion of the lateral condyle and then displaced between the condyles of the femur and the head of the tibia, and simulated a fractured dislocated meniscus. This was repaired by Dr. Callahan. A strand of silk was tied into the upper proximal end of the anterior cruciate ligament, the silk was drawn back through the condyle and sewed into position. I want you to watch this man walk.

YOU must realize that cruciate ligament injuries are far more common than is supposed. We want you to recognize them, then make as accurate a diagnosis of a knee joint injury as you possibly can before you immobilize the joint, because x-rays will not give you an accurate diagnosis after immobilization has been completed. In other words, the diagnosis must be a combination of roentgenologic and physical findings.

We have another case of posterior cruciate ligament rupture. This man is a fireman. It is about four and one-half months since we operated upon him. He still has a weak knee. We have used a new procedure here. We took the aponeurosis of the ruptured collateral fibular ligament and used that as a substitute for the posterior cruciate ligament. We did not take the aponeurosis of the biceps femoris, as in our first case, because we had a loss of function of this muscle, and since then we have devised another method so as not to lose the function of so important a muscle as the biceps femoris. This man has one-half inch anterior posterior motion. Four and one-half months is a very short time when you are dealing with the repair of this condition. We are hoping that as soon as the quadriceps muscle and other muscles become stronger there will be less of this abnormal mobility. He has about one inch less anteroposterior motion of the tibial head on the femur at the present time than he had at the time of operation.

These wounds upon the knee joint are dressed just as we dress a compound wound. We figure all joint wounds are compound wounds. We are sure that the fluids of the body that flow out will clean these wounds if they are given a chance to wash out what dirt is left in. Out of over 1000 cases of knee joint, patella, and meniscus injuries we have not had an infection.

FRACTURES of the condyle of the tibia are a very definite entity. That the great majority of the deformities and disabilities can be obviated by operation goes without saying. We classified these in a recent article into:

"Fractures of the Lateral Condyle with Displacement";

"Fractures with Depression of the Medial Portion of the Lateral Condyle";

"Fractures with Depression of the Entire Condyle";

"Fractures with Depression of the Posterior Portion of the Medial Condyle"; and

"Fractures with Depression of the Anterior Portion of the Lateral Condyle."

This last type is rare.

This patient had a trick knee joint which would throw her as she walked. It was due to a depressed fracture of the medial condyle of the tibia. Two years after her accident this medial condyle was elevated, supported with bone fragments and a heavy steel screw. As you see, there is little if any disability present at this time. She states that the limp is due to a painful ankle, but this does not interfere with her labor as a waitress.

This is a man Dr. Callahan operated upon one year ago for a depressed lateral condyle, 35° of lateral motion and an inevitable knock knee. As you can see, he walks without a limp and has a normal knee.

This next case is relatively recent. The looseness of the knee joint caused us to make a questionable diagnosis of injured cruciate ligament, but when we operated the condition found was that of ruptured collateral tibial ligament. These ligaments were stabilized and at the present time you see an individual with a practically normal knee.

In our closing remarks we wish to emphasize again the absolute necessity of making an exact clinical diagnosis of the degree of excess motion in a knee joint, both when it is extended and when it is flexed, before any immobilization is made. This is absolutely necessary if you wish to avoid subsequent repair of injured cruciate ligaments, because we know that the early immobilization of a knee joint with ruptured ligaments will give a complete restoration of function. Whereas, if they are not immobilized for an adequate length of time the surgical repair of these ligaments will be absolutely necessary before function can be restored.

Intravenous Fluids

— *Practical Considerations, in Shock, Dehydration, Starvation, etc.* —

by

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THE EARLY history of the administration of intravenous medication is rather vague and conflicting.* It dates back to the year that Columbus discovered America, at which time a Jewish physician bled three boys to death in an effort to administer a transfusion to Pope Innocent VIII.

It appears more logical to assume, however, that the blood was administered as a drink rather than intravenously, for the discovery of the circulation of the blood was not announced by Harvey until 1628. Harvey's discovery paved the way for intravenous medication, and Richard Lauer of England performed the first successful transfusion of blood on lower animals in 1665. Jean Baptiste Denys, of France, performed the first authenticated blood transfusion upon man in 1667. He administered the blood of a lamb to a youth dying as a result of repeated venesections, and a remarkable recovery was made. He performed a similar experiment upon several other patients and reported the passage of black urine, which evidently was due to the massive agglutination and hemolysis resulting in hemoglobinuria. In 1901 Landsteiner divided human blood into three groups, and in 1907 Jansky and later Moss classified blood into the four groups that are in use at the present time. In 1907 Crile employed a direct method of transfusion, and in 1914 Hustin, of Belgium, and later Lewison, perfected the sodium citrate technique that is employed almost universally.

Following these discoveries, intravenous injections of all kinds have been administered very energetically. A few years ago I found that our little group were administering intravenous medications, salt solution, dextrose solution, etc., in a rather haphazard and seemingly unintelligent manner. In an effort to standardize the administration of these various fluids, I had some of the younger men review the literature, and they found such conflicting reports that it was almost impossible to formulate a definite set of rules for our hospital. The fluid problem became very acute in one of the larger hospitals in our section of the country, and the internes were assembled for discussion. They were unanimous in declaring that fluids by the intravenous route were ordered so liberally, both as to quantity and frequency of injection, as to consume a large part of their time and prevent adequate history taking. This situation stimulated Dr. Clyde R. Jensen, of the King County Hospital, to make an extensive review of the literature in an effort to formulate a set of rules for the intelligent administration of intravenous fluids. This he did successfully, and it is from his report in articles of the March, April, and May numbers of *Northwest Medicine*, 1935, personal communication, and other references that I am here suggesting certain principles that should be taken into consideration in the administration of intravenous fluids.

It should be remembered that when fluid is injected into the blood stream it is not being injected into a system of closed and rigid tubes.

Mechanically speaking, the elasticity of the blood vessels is important in that it allows of moderate variation of blood volume. The general capillary network allows of a free interchange of fluids between the tissues and the blood, while the capillarise of the kidney provide an outlet to the exterior. Fluids given intravenously are thus subjected to these influences. In order further to understand the subject it is necessary to study some of the physiological and chemical principles concerned with fluid administration.

A COMPLETE circuit of blood is made in approximately 23 seconds. Thus fluid introduced into the vein is quickly subjected to the action of the capillary walls. The capillary wall is a semi-permeable membrane, and allows the free passage of materials in solution if they are diffusible. The blood contains large quantities of water and diffusible substances, i.e., salts (electrolytes), urea, sugar, etc. The tissue fluid likewise contains diffusible substances of similar nature in like concentration, and therefore the osmotic pressure exerted by these substances is in balance. But the blood in addition contains non-diffusible plasma proteins that exist in colloidal state, and because they are unable to permeate the capillary membrane, they exert a positive osmotic pressure attracting water into the vessel. This positive effect, exerted by the blood colloids, is counterbalanced by the hydrostatic pressure which tends to force water from the blood into the tissues. Thus a relatively constant blood volume is maintained. I do not know whether or not I have given this to you as scientifically as I should, but an understanding of these principles is essential. I am going to show you a diagram that probably will describe it to better advantage.

Normally a definite balance is carried at all times. Fluid introduced into the blood stream may momentarily increase the blood volume and elevate the hydrostatic pressure, but the vascular channel quickly adapts itself and so restores normal relationships. Of course there is usually no need to give fluids intravenously to normal individuals, so our discussion deals with the administration of fluids to persons low in liquids, low in salts, or low in sugar or some particular ingredient necessary for treatment.

I should like to discuss first the substance most frequently used, which is dextrose. Why do we use dextrose? This substance may be used to supply food to the body in general, and to replenish the glycogen supply of the liver. As you undoubtedly know, a moderate amount of nourishment may be administered in this manner, for one gram

*Presented before the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East), Chicago, November 15, 1935.

of glucose yields four calories. Because of its water-binding properties it may serve to attract water to the blood vessels or tissues or to the outside by way of the urine. Its action depends upon the concentration and the rate at which it is administered. This of course is guided by the state of the circulation and the general condition of the patient. If given to combat dehydration, it is administered in an isotonic solution, which is about 5% in water. If given to produce dehydration, namely as a diuretic, it is given in concentrated solution, 10 to 50%, and at a fairly rapid rate. This action depends upon the fact that if glucose is given at a rate faster than .4 gram per pound of body weight per hour it cannot be fully metabolized and is spilled over into the urine, carrying water with it. Also I might add that for ketogenic types of acidosis, dextrose is a specific. Of course the patient has to furnish the necessary insulin to make this possible, or, if he is deficient, careful administration by the physician is essential. I am not prepared to discuss this subject at length, but it is something with which you must be familiar. If these solutions are to be given, a knowledge of the fundamental principles that I am stating is essential.

Isotonic and hypertonic solutions of sodium chloride are the chief inorganic salt solutions employed. When saline solution is introduced into the blood stream, the colloids are momentarily diluted and the osmotic pressure exerted by them lowered. This allows water and diffusible elements to flow out of the blood stream into the tissues until balance is again restored. It has been said that five minutes after the injection of isotonic salt solution in large quantities the blood volume is practically restored to normal, because of the marked diffusibility of the salt. Thus it can be seen how futile it is to attempt to raise and maintain blood volume by the use of isotonic salt solution. In fact one may force saline solution to the point of clinical edema and perhaps convulsions, and not effect a maintained increase in blood volume. This is a practical point of great importance, as will be shown later, and should be remembered in the future if we continue to use saline solutions intravenously.

After the injection of hypertonic salt solutions, great quantities of water are attracted to the blood vessels. This is only a transient effect, as the blood volume is quickly restored to its former level because of the rapid diffusibility of the salt. Another point of great importance is that water is required for excretion of salt through the kidneys. If the concentration of salt in the plasma is above normal, there is interference with the normal excretion of fluid through the kidneys, with resultant retention of water and development of clinical edema. This may be pushed to the point of causing edema of a vital organ, or other manifestation of sodium chloride toxicity. A point of importance between dextrose and salt when harbored in the tissues is that the former is metabolized while the latter is retained as such. On this account the excessive administration of glucose is not as dangerous as the excessive administration of salt.

CLINICAL consideration of the intravenous administration of the three solutions, blood, dextrose, and salt, appears to be in order. The first to be discussed is dehydration. Dehydration is a rather difficult subject to approach chemically and physiologically, but we who have seen patients in coma many times are familiar with the clinical picture. There are two simple practical points that I wish to emphasize. The first is thirst. This is a symptom that should be seriously considered, but unfortunately the patient may not be able to inform us because of his physical condition. The second is a determination of the specific gravity of the urine. In a dehydrated patient the specific gravity of the urine goes steadily up, and it is important to follow it closely in our post-operative cases, cases of shock, etc. The test is extremely simple, and our nurses measure and record the specific gravity of the urine on the charts of all patients in whom it is essential to watch fluid intake. The one exception to this occurs in patients with chronic renal disease. In them the specific gravity tends to become fixed at 1.010 and the test is no longer a reliable guide to the degree of dehydration.

In treating dehydration it is necessary to administer fluids and restore the normal water balance. If water cannot be given by mouth, the intravenous administration of 5% dextrose solution is very efficient in restoring water to the depleted tissues. Usually a certain salt deficit has been incurred because of vomiting, in which case one may give isotonic salt solution. Not infrequently the first injection consists of a 5% dextrose in saline solution followed later by either or both as the clinical condition warrants. Lest I forget, I should like to mention one condition in which caution must be used. In a patient, in whom for some reason or other there has existed a relative state of undernutrition, continued use of large quantities of fluids may further dilute the already lowered plasma colloids. This may result in the development of clinical edema because of the decrease in their osmotic effect. To remedy this condition, blood transfusions are given as a supplementary measure to restore the plasma colloids to their normal level.

Starvation is intimately related to dehydration, and it is difficult to discuss them separately. The one deals with the deprivation of water and food and the other with the deprivation of water alone. In the treatment of starvation intravenously, we not only supply food in solution but also water. Dextrose solution is the substance used. It should be remembered that if given at a rate faster than .4 gram per pound per hour it will not be fully metabolized and will spill over through the kidneys. In this manner we really defeat our purpose by producing a degree of diuresis and dehydration. As one gram of dextrose yields four calories when fully metabolized, a moderate amount of nourishment may be given. Of course if we use dilute solutions, such as 5% dextrose, it would require 3000 cc. to yield 150 grams, which multiplied by four yields only 600 calories. However, more concentrated solutions may be employed, even as high as 50%, and if not given above the tolerant rate, as many as 1000 to 1200 calories may be administered in one day. Of course this method of supplying nourishment cannot be carried on indefinitely, but it serves as an excellent temporary measure.

The subject of acidosis and alkalosis offers at all times interesting material for discussion. As you remember, in the old days patients caused a great deal of apprehension as to whether or not a condition of acidosis or alkalosis existed. In the treatment of nonketogenic types of acidosis, sodium chloride is a specific. This is a practical point of

great importance. It has been found that if a condition of acidosis exists the body retains sodium and casts off chlorine; whereas if a condition of alkalosis exists the body retains chlorine and casts off sodium. Thus saline solution is a specific for this type of acidosis and alkalosis.

Dextrose solution is a specific for ketogenic types of acidosis and may or may not be supplemented with insulin as the condition warrants. The existence of these conditions in children is usually treated with more elaborate and complex solutions.

I know you were given a paper on vomiting and intestinal obstruction, and I am sorry I could not have heard it. In cases of high intestinal obstruction there is considerable vomiting, with loss of fluids and chlorides. If the vomitus includes the duodenal contents there is likewise a loss of base, but a condition of alkalosis is produced in either case because of the relatively greater loss of chlorides. In these cases, salt solution intravenously is imperative in an effort to replenish both the salt and the water depletion. It has been shown experimentally that the lives of dogs with high intestinal obstruction can be prolonged in this manner. In low intestinal obstruction a similar condition exists, but toxic symptoms are slower in appearing and are less acute. The suction apparatus demonstrated by Dr. Wangensteen is very effective in keeping the stomach empty. If such an apparatus is used in combination with liberal quantities of sodium chloride and fluid intravenously, the average case of intestinal obstruction need never demand an emergency operation. I was somewhat distressed and shocked to learn the number of patients operated upon in the middle of the night for intestinal obstruction. It must be remembered, that except in dire emergencies, these patients must first be treated until the blood chemistry and fluid balance is restored to nearly normal. Many patients heretofore lost may be saved by several hours of preliminary treatment with intravenous saline and glucose, and perhaps a blood transfusion. They become much better operative risks. Hypertonic solutions may check for a time the excessive secretion of fluids into the intestinal tract because of the temporary increase in osmotic pressure of the blood. These principles are very simple, but one may become somewhat confused and aghast when he hears them for the first time. They are the one, two, three, four that must be understood if the performance of major surgery is to be continued in our hospitals.

SHOCK and hemorrhage are two conditions which are very interesting to all of us concerned with "railroad" surgery. I shall not discuss the many theories dealing with the cause of shock, but we are all familiar with the clinical picture. The thready pulse, lowered blood pressure, anxious brow, and generalized pallor have been seen all too frequently. The saddest thing to me is to see a young man with legs crushed smoking a cigarette, when I know that his time on earth can be almost determined in minutes. The cause of this condition is thought to be a marked lowering of blood volume, and our problem is to restore this and maintain it.

There are two types of surgical shock: primary and secondary. Primary shock occurs immediately, is of reflex origin, and is the result of fear or pain. It is attended by a marked degree of vasodilatation, as a result of which we bleed into our own vessels. This phase of shock does not occur in an anesthetized individual, and may be treated to a certain extent by analgesics and other drugs. It may pass imperceptibly, within a short time, to the phase of secondary shock. This form of shock is due to the excessive loss of fluid or blood itself from the vessels into the traumatized area or tissue spaces. The essential point to remember is that blood volume has been reduced and must be restored and maintained.

Are we going to give a patient in shock saline or dextrose solution intravenously? These two solutions will correct any degree of dehydration that may be present, but because of their great diffusibility any increase of blood volume or blood pressure effected by them will be only temporary. I do not say these substances should not be given, but, to repeat, our aim is to restore and maintain blood volume. This reduction has come about because of large losses of fluid containing both electrolytes and plasma colloids. What are we to give them?

Blood transfusion is the procedure of choice and should be employed without delay. It increases the colloid content of the blood and thus combats shock. Many times blood is not immediately or remotely available. What, then, are we to do? During the great war acacia solution was used extensively to combat shock, but was abandoned because of severe reactions. Now several of the larger drug houses furnish a refined acacia product that is very satisfactory for intravenous use. It acts by producing a colloidal suspension that passes through the semi-permeable capillary membrane only with great difficulty, and in this way tends to restore and maintain blood volume. It is usually given in 300-600 cc. amounts of a 6% solution. It cannot be added to citrated blood, as clots will form as a result of precipitation of calcium.

THE next subject of discussion is burns. I know of nothing that has caused so much concern as these unfortunate cases. For many years it had been stated that a burn involving one-third of the body was invariably fatal. That this was so, was due to the former inadequate treatment. It has been only within the last several years that the true underlying changes in burns have been discovered. In burns there is a large outpouring of plasma fluid—in amounts almost too large to believe. If a patient incurs a burn covering one-sixth of the body surface he will lose fluid amounting to about 70% of the blood volume in 24 hours. If he weighs 150 pounds he will lose about 3500 cc. of fluid in 24 hours, as his total blood volume is about 5000 cc. To go a little further, the same patient with a burn covering one-third of the body would lose 140% of his blood volume, or 7000 cc., in 24 hours. It can easily be seen why treatment in the past has been inadequate. These patients need large quantities of fluids in the form of saline and glucose, and blood transfusions, when available, to replenish the plasma colloids. We must remember that a patient with an extensive burn is to be treated somewhat on the same order as that outlined for the treatment of shock.

In closing, I shall discuss a subject about which there has been much disagreement. I cannot expect you to agree entirely with my views, and trust time will permit of after-discussion. The administration of hypertonic solutions intravenously in the

treatment of patients with increased intracranial pressure has become a rather widespread procedure. Before discussing the fate and actions of these fluids, let us visualize the structure of the brain. It is encased in a rigid bony cage. There are three distinct types of fluid: the cerebrospinal fluid, blood vessel fluid, and tissue fluid. While these fluids do not mix, a change in the quantity of one affects one or both of the remaining fluids. The cerebrospinal fluid is the one usually studied clinically because of the ease with which it is observed. This fluid, secreted by the cells of the choroid plexus of the ventricles, passes through the ventricular system, out through the foramina of Magendie and Lushka, and then over the surface of the brain. It is then absorbed through the pacchionian bodies into the venous circulation.

When hypertonic solutions are injected, what takes place? In the first place I might add that hypertonic salt solutions have no place in the treatment of increased intracranial pressure. While they may produce a temporary lowering of pressure, the after-effect would defeat their ultimate purpose, for reasons given in the earlier part of this paper. When hypertonic dextrose solution is injected intravenously the osmotic tension of the blood is markedly increased, the secretion of fluid through the pacchionian bodies is increased. In addition there is a flow of fluid from the tissues of the brain to the vascular system. These changes produce a lowering of intracranial pressure, although the effect is not continuous. It has been found that after about three hours the pressure swings back and may return to or exceed its former level. This occurs because of a return flow of fluid from the vessels, but is offset in part by the diuretic action of the hypertonic glucose. As stated in the earlier part of this paper, dextrose is an efficient diuretic when administered at a rate exceeding .4 gm. per kg. per hour. In view of this after-reaction, it would seem to me that the administration of hypertonic dextrose solution should be made at intervals of about two and a half to three hours to maintain a steady reduction of intracranial pressure. I have seen patients slowly become comatose three to four hours after the initial administration of hypertonic dextrose, who probably would have been greatly benefited by another injection given after the proper interval. I might add that the glucose solution is usually given in 50-100 cc. amounts of 50% solution.

I am bringing this to you today because I feel that an understanding of the principles involved in the administration of intravenous fluids is very important.

Blood Drip Transfusion

By CHARLES A. KATHERMAN, M.D.,
Sioux City, Iowa

FOR many years now we have recognized and used with great value the introduction of saline and glucose and water in considerable quantities and for a great variety of emergencies.* The use of these solutions has not been confined alone to emergencies, but, as you all know, they have been used for pre-operative preparation as well as for various and sundry diseases by the internist. Furthermore it has been the common practice among all of us to employ blood transfusions when the need was apparent, and perhaps it is not going too far to say that the employment of blood transfusion has been done with markedly increased frequency as the years have gone by. There can be no doctors in this audience who have not employed this method of treatment many times, and I think all will agree that they are less hesitant to do this at the present time than they were some years ago.

The great merit in the use of glucose and saline solutions is that it allows large amounts of fluid to be introduced slowly and under perfect control. The drip device for blood transfusions, however, seems to have been original with Marriott, and we believe there is a considerable scope for this form of transfusion.

I have had but very little experience in carrying out the procedure and treatment which I am about to discuss in this essay. However, the procedure is so simple and its value so great that it occurred to me, on the spur of the moment, that a talk on this subject with the hope of bringing out from others their ideas of its value would be both timely and instructive. This subject was first brought to my attention by an article appearing in the *Lancet* in April of this year. The author was Dr. H. L. Marriott, Middlesex Hospital, London. Practically all that I will have to say is a digest of this article, even going so far as to repeat his reports in a few of his cases.

It is our conviction that blood transfusion is today exploited only to a small extent of its potentiality because it is being employed in homeopathic doses. There is far from a general realization of the fact that a transfusion of 500 cc. to an adult does no more than augment his hemoglobin by some 8 to 10% of its normal value. It is the more surprising that this valuable method of treatment is so feebly used when blood is easily and freely available everywhere.

The drip method is, firstly, essentially for large transfusions, but it is necessary to point out that a liter to an adult of 150 lbs. is roughly parallel to a transfusion of 46 cc. to a baby of 7 lbs. Large may be arbitrarily but serviceably defined, as such, if it exceeds 5 cc. per pound of recipient's body weight.

The drip method is, secondly, a slow, controlled transfusion. It enables the blood to be introduced over a period of time. For the administration of large quantities of blood it is obvious that more than one donor is required. The assembly of numerous donors is easy if properly organized, and I need not go into the necessity for proper grouping. Marriott used 100 donors for 17 cases.

Bleeding in pairs at 8 a.m., and 8 p.m., was found convenient. The amounts taken varied from 200 cc. to 900 cc., according to age, weight, sex and physical condition.

TECHNIQUE: The principle difficulty in transfusing with citrated blood for the drip method, as compared with saline, is that the corpuscles tend to sediment and block the drip bulb. This makes necessary some method of continuous aseptic stirring of the blood. This has been achieved by bubbling a continuous stream of filtered oxygen through the blood.

APPARATUS: 1. An oxygen cylinder with pressure regulator and fine adjustment tap.

* At a meeting of the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East), at Chicago, November 15, 1935.

2. Five feet of rubber tubing interspersed with three filters, and which connect the cylinder to

3. A glass reservoir of 2 pt. capacity, fitted with a rubber bung with two perforations through which project glass tubes—one for the oxygen and the other to serve as outlet for the oxygen. On the under side of the bung a rubber tube reaches to the bottom of the reservoir for the bubbling of the oxygen. The base of the reservoir is fitted with a circular gauze filter made of 28 gauge pure nickle wire, which serves to strain off any clots. The reservoir fits into a tin hanger.

4. Four inches of tubing to connect the reservoir with a

5. Laurie drip bulb joined to

6. Seven feet of tubing 5 mm. in diameter, attached to

7. A glass cannula—much like the glass part of a medicine dropper with a slightly bulbous tip.

OUR choice of position has been the middle of forearm—a vein being selected, if possible, with a valve an inch or more proximal to the site for the cannula. Such a valve prevents reflux flow, which may occur. The bend of the elbow is the least suitable (on account of compression of the cannula against the vein, in flexion). The patient can flex his elbow as he wishes during administration. The reservoir with tubing is fixed at least three feet above the vein. A still greater height insures less variation in the flow of many hours or even several days. In transfusing for anemic conditions it is possible to calculate very roughly the amount of blood required, from the deficiency of the hemoglobin below an ideal of 100%, allowing 500 cc. of blood for each 9% of deficiency. It is wise to start the drip flowing using saline rather than blood, and the next step is to remove the bung and introduce enough saline to cover the nickle gauze to a depth of one-half inch —about 100 cc. Under usual asepsis the operator, with injection of 1% novocaine, incises the skin, displays the vein under blunt dissection, and inserts the cannula—the distal end of the vein having been ligated and another ligature having been passed behind the bulbous tip of the cannula.

The next step is to start and control the flow of oxygen in the reservoir. Bubbles can be observed in the saline at the base of the reservoir. About 60 to 120 bubbles per minute will keep the blood adequately stirred. A faster rate results in troublesome frothing. The oxygen has the minor merit of delivering the blood in an oxygenated condition. Up to 1500 cc. of citrated blood may now be conveniently introduced into the reservoir by removal of the bung and pouring it in. The screw clip is adjusted till the desired rate of flow is obtained as observed in the Laurie drip bulb; a convenient rate of flow is 40 drops per minute, equaling a liter in 7 hrs. or a pint in 4 hrs. The nurse should be instructed to inspect the rate every half hour for any required adjustment of the rate. Otherwise there is no further need to touch any part of the apparatus beyond periodical replenishment of the reservoir with blood. The patient may use his arm freely and turn over in bed, and sleep in any desired position. The patient is often oblivious of the presence of the cannula in his forearm.

It is very important that the citrate and saline solutions be prepared from distilled water entirely free from dead organism, to avoid troublesome rigors which otherwise are inevitable.

CASE 1: Patient, a male, aged 27, suffering from severe ulceration colitis, who had been ill for six weeks. His general condition was extremely poor and he was running a swinging temperature touching 103° in the evenings, and with a pulse rate ranging around 130. Ordinary therapeutic measures had failed to arrest his downward progress, and a fatal issue appeared imminent. The hemoglobin percentage estimated immediately before commencement of the drip transfusion was 35.

Drip transfusion was maintained for 27 hours, during which 3400 cc. of blood and 700 cc. citrate solution were introduced. Hemoglobin estimations were carried out at intervals, and at the end of the transfusions his hemoglobin was 98%. The improvement effected in his general condition was remarkable. His complexion changed from extreme pallor to a rosy pink, his demeanor changed from that of a dying man to an optimistic invalid. His temperature dropped to normal and there was no more blood in the stools up to the time of his discharge from hospital.

CASE 2: A man, aged 37, known to have a large duodenal ulcer, admitted suffering from severe melaena. When we started drip transfusion he had been bleeding five days. His hemoglobin was 30%. His condition was such as to make operation then quite unjustifiable.

Forty hours were taken in transfusing 4600 cc. of blood and 800 cc. of citrate solution, i.e., 9½ pts. total. His hemoglobin rose to 105%, and he felt and looked enormously improved. Operation disclosed a large duodenal ulcer the base of which was partly formed by gall bladder and pancreas. Partial gastrectomy was performed, and the first part of the duodenum removed with part of the ulcer. At the end of the operation, the patient's pulse rate was 84. He made an uninterrupted recovery.

ANEMIAS fall into two primary categories: deficient formation on the one hand and excessive loss or destruction on the other. The normal red cell count in adults varies from 4½ to 6½ million in males and from 4 to 6 million in females. Hemoglobin percentage ranges from 95 to 117 and from 85 to 111 in respective sexes. Anemia exists when the figures are below the lower normal limits.

In anemia, owing to subacute or chronic bleeding, the indications for drip transfusion might be conditioned by a variety of circumstances. Thus in severe anemia, owing to a readily arrested source of bleeding, such as piles, there seems to be no need for transfusion unless the patient's life is jeopardized by some complicating infection. On the other hand, in severe anemia, owing to hemorrhage whose arrest necessitates a major operation, drip transfusion would have one of its chief functions. The high mortality in recurrent hematemesis and melaena from peptic ulcer is well known, and the dilemma of having to choose between hoping the bleeding will stop in the morphinized patient, or operating to arrest it, too often results in death, whatever the choice made. There seems no doubt that in such cases surgery would be the method of election if it could be made safe by preliminary relief of the exsanguin-

ation. Drip transfusion can achieve this aim, and the patient be delivered to the surgeon with 100% hemoglobin and accompanied to the theatre with the drip still running. We have done this in two cases. Again, in a severe operation, such as Wertheim's hysterectomy, the mortality is unquestionably higher when operation is performed on an already anemic patient. Twenty-four hours' delay for drip transfusion of several pints of blood might surely lower the death-rate figures in such cases.

Discussion has been limited to the possibilities of continuous drip blood transfusion in the treatment of the anemic states where the indication appears fairly clear. We are not unmindful, however, that the method might have value in conditions not essentially characterized by anemia. Brilliant results from blood transfusion of the ordinary type have been recorded in almost every conceivable condition. It may be that, in a not negligible fraction of these, cure was rightly ascribed to transfusion, and that failure of consistent confirmation of beneficial results has been due to under-dosage.

Discussion:

DR. W. E. CLARK, Oshkosh, Wis.: I would like to ask about the development of sterile phlebitis following the use of glucose.

DR. W. C. KAUFMAN, Appleton, Minn.: How is the solution kept warm?

DR. FRANK S. SKINNER, Marion, Iowa: Did you have any unfavorable results?

DR. C. A. KATHERMAN, Sioux City, Iowa (closing): It is well known that certain solutions of glucose will cause phlebitis. I do not know what experience other men have had, but I have never had phlebitis following blood transfusion in the ordinary way. Solutions of glucose along with many other sclerosing solutions were and are used in the treatment of varicose veins. I do not believe any one finds phlebitis occurring following 5 to 10% solution of sugar, certainly not with the 5% solution. I have had so little experience that I would not say that the continuous drip method might not cause phlebitis. I see no reason to fear it. If it did, I think that would be a minor complication when we consider the type of case in which prolonged transfusion might be indicated.

Keeping the solution warm is a matter for hospital management. We keep it warm the same as we keep an enema drip warm. Hot towels can be wrapped around the solution. It is replenished twice a day, which allows the solution to become cold unless hot towels or other means are used to keep the container warm.

Regarding unfavorable reactions, I judge the doctor who asked that question was thinking of some of the times when the blood transfusion did not go as well as we would like to have it go. It is my conviction that reactions following any type of blood transfusion are due very largely to the type of water that is being used. We have the same thing following salvarsan injections, when perhaps a pint is used. I think with double distilled and triple distilled water, which can be obtained in any city of any size rather quickly, the matter of getting the proper type of water is rather easily solved.

I want to emphasize what you obtain when you transfuse a patient: 500 cc. of blood makes a 9% increase in hemoglobin in an average adult subject. If you have an anemic patient down to 25 or 35% hemoglobin and you want to bring it up to 70%, there is no reason why you cannot give a transfusion of sufficient size to accomplish this.

X-Ray Studies of Dusts

By VICTOR HICKS,
University of Pittsburgh

DUSTS have been recognized for some time as important industrial hazards; inhalation of them over long periods is generally held responsible for the production of various pulmonary and associated diseases known as the pneumoconioses. These diseases have been classified according to the pathological conditions produced and the nature of the dusts supposed to cause them: silicosis, from free quartz; anthracosis, from coal dusts; siderosis, from iron oxide; asbestosis, from asbestos; and so on. But the manner in which these diseases are produced and the exact role played by various dusts is not entirely clear.

The University of Pittsburgh is cooperating with the Bureau of Smoke Regulation of the City of Pittsburgh, the Mellon Institute of Industrial Research, and the Allegheny General Hospital in an extensive study of dusts in relation to the pneumoconioses, particularly silicosis and anthracosis. Biochemical[1], pathological[2], spectroscopic[3], petrographic[4], and x-ray diffraction studies are being applied to this problem. Any one of these methods alone is admittedly insufficient. For example, the difficulty of estimating petrographically the amount of free quartz present in a very finely divided material is well known. Again, the state of combination and structural form of the silica is important, as free silica might be suspected to produce different pathological results than combined silica, and this distinction cannot usually be made by the conventional methods of chemical analysis when there are complicating factors as in this study.

A brief report of the x-ray diffraction studies is given here. As these studies were recently started, this report must be considered entirely as preliminary.

Experimental Methods

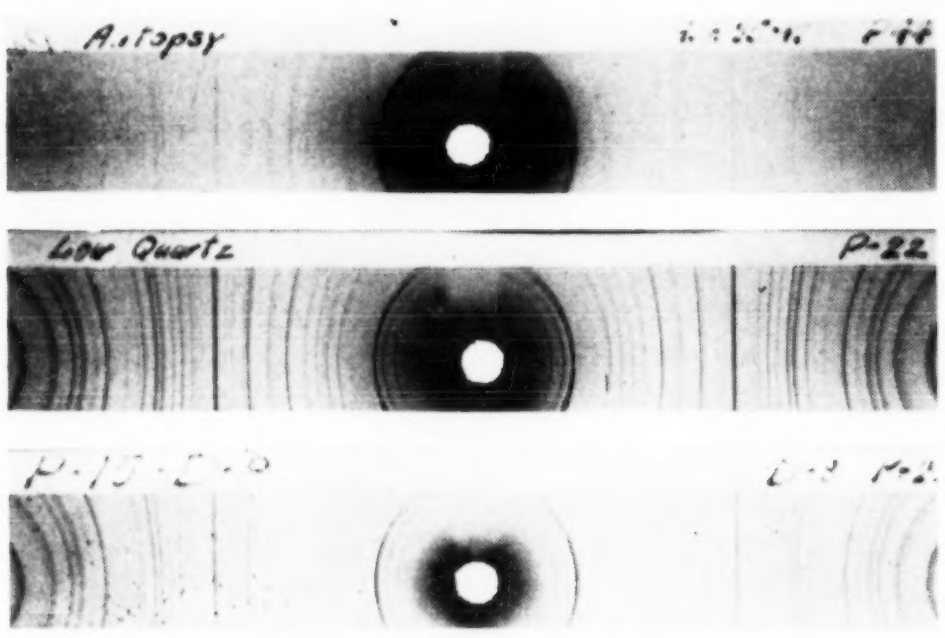
THE Debye-Scherrer x-ray diffraction method has been found entirely satisfactory so far. Cylindrical cameras of 57.3 mm. diameter have been employed. Filtered copper radiation has been used whenever the materials studied would permit, but as iron is frequently encountered in large amounts, iron radiation, unfiltered to save exposure time, has been more generally employed. The specimens photographed were compact rods made by extruding, from a glass capillary tube, a mixture of the material in question with collodion. Identifications have been made either by comparison with reference photograms or by comparisons of interplanar spacings plotted on partially transparent, semi-logarithmic, coordinate paper.

Dusts

INDUSTRIAL dusts from a steel mill and a glass factory have been studied. Air-borne dusts from the Pittsburgh district and elsewhere have also been examined.

1. STEEL MILL DUSTS: An example of an identification is shown in the figure. The dust was collected in a steel foundry from the accumulations near the sand blast. The identification of low-quartz from the diffraction pattern of the dust shown in the lower portion of the figure is unmistakable on comparison with the diffraction pattern of that mineral shown in the center.

In a similar manner, low-quartz was found to be the major constituent of the dust obtained near the cleaners in the same steel mill. The workers in the places where these two dusts were



Autopsy: Low Quartz: Factory Dust

obtained have not all used standard respirators or else have worn none at all, and indications of silicosis or similar diseases have been found among these employees.

2. GLASS FACTORY DUSTS: An equally conclusive identification low-quartz was obtained for a sample of dust accumulated on the beams and ledges in the sand unloading room of a glass factory. The petrographic studies indicated the presence of some additional crystalline substance, and this was confirmed by the x-ray photogram, although the substance was not identified. However, the petrographic studies at first indicated that the major constituent, based on a particle count, was some carbonaceous material, which was not detectable in the diffraction photogram. When it was recognized that some of the quartz particles might be covered with this material, and that the quartz particles were generally larger, the two results were brought into closer agreement. This clearly indicates that a particle count alone is qualitative and that for quantitative results, particle size must also be considered.

In a similar manner, calcium fluoride has been identified as the major constituent in the dust from the batch room of the same glass factory.

3. AIR-BORNE DUSTS: The examination of dusts deposited on the exteriors of several Pittsburgh buildings has indicated that free quartz is an important constituent of the air-borne dusts in this vicinity. Ferric oxide has been tentatively identified as a second constituent.

Dust from the Holland tunnel under the Hudson river has been found to contain appreciable amounts of free quartz; uncombined iron is also possibly detectable. In this case the spectrographic analysis indicates the presence of appreciable amounts of lead; an attempt has not yet been made to determine the state of combination of this element.

Deposits on Human Lungs

SIMILAR studies are being undertaken to determine the nature of the deposits on human lungs obtained from autopsies.[1,2,3,4]

X-ray diffraction photograms of the dried lungs have generally shown only a few weak lines in addition to a broad band ascribable to the tissue; in some cases these lines have been found to match those in the pattern of low-quartz.

Many of the samples available to us have been kept in formalin or other preservatives, so that a chemical treatment or ashing must be employed. It has been recognized that chemical treatments may alter some of the compounds which are sought. We have found that free quartz either is lost or enters into combination during certain reductions by ashing. The most satisfactory method so far developed is digestion in trypsin, but this can be used only with fresh lungs. Thus it will be seen that the work so far has been chiefly concerned with the method of separation of the tissue from the deposit. When this separation was accomplished by one means or another, more satisfactory photograms were obtained.

An example of the type of photogram obtained is shown in the upper portion of the slide. The sample in this case was prepared by digestion in trypsin. Low-quartz is detectable, and other substances are definitely present.

A photogram of the residue left after ashing this lung indicates the presence of two or more major constituents which are different from low-quartz; similar patterns have been obtained from other ashed samples. However, free quartz has been found as a major constituent in several other instances when the samples were prepared by methods other than ashing.

An attempt is being made to identify the compounds other than free quartz deposited on the lung tissue with the aid of information obtained from the case histories, and from the combination of spectroscopic, x-ray diffraction, and quantitative chemical analyses. As an aid in this part of the work, x-ray diffraction data are being collected from published sources and from reference photograms.

No correlative petrographic analyses have been attempted on these residues, so that comparative evalutions of the x-ray and petrographic methods can not be made as yet. Microscopic examinations of ashed microtome sections from lungs, however, have indicated that identifications would be rather diffciult by this microscopic method.

It is hoped that more definite results than can be given in this preliminary report will be available at the time of the next x-ray symposium.

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1. The biochemical studies are being undertaken by Dr. Olive McElroy, of the University of Pittsburgh, and Miss Pauline Hopfer, at the Mellon Institute.

2. The pathological studies are being undertaken by some of the staff of the Allegheny General Hospital, of Pittsburgh, under the direction of Dr. Samuel R. Haythorne.

3. The spectroscopic analyses are being carried out by Miss Mary Warga, at the University of Pittsburgh.

4. The petrographic studies are being made by Dr. Frank F. Rupert, at the Mellon Institute.

Fractures of the Os Calcis

— With Summary of Twenty Cases —

by

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FRACTURES of the os calcis have frequently been referred to as "problem fractures".

The significance of this expression lies in the fact that there is a variance as to treatment and an uncertainty as to the end result.

There are some surgeons who claim that the functional end results obtained in the so-called untreated cases equal those in which an attempt at correction has been made.

Types of Fractures

FRACTURES of the os calcis are said to comprise 2% of all fractures.

These fractures of the os calcis may be divided according to the classification of Dr. John J. Moorhead into Type 1, or displaced, variety, or Type 2, in which the displacement is of minor importance. They may also be divided into intra- and extra-articular fractures. This classification, in our opinion, has a great bearing upon the ultimate outcome, in that those extending into the tarsal joints inevitably produce marked arthritic changes. Except in those cases in which there has been a small chip fracture, a severe degree of comminution is to be expected.

In our experience, compound fractures are exceedingly rare and only encountered in those cases where there has been divulsion of the heel due to a direct crushing violence. The type of violence producing the fracture may be considered a direct one, in that it is caused by a direct fall on the feet, in which the weight of the body is transmitted through the tarsal bones and crushes the os calcis and in so doing shortens the entire length of the affected extremity. It is not infrequent to have a bilateral fracture involving both the os calcis.

Pathology

THERE are three important displacements in the more severe types:

1. A shortening of the length of the bone, in that the posterior fragment is driven anteriorly or impacted into the anterior fragment, or that portion of the bone articulating with the cuboid.

2. A widening or squashing out of the fragments, occasionally spicules of bone, which have been forced outward almost perforating the skin on the lateral and medial surface of the heel. We have never encountered a compounding associated with lateral displacement.

3. Flattening of the upper surface of the os calcis, which normally produces an obtuse angle where it articulates with the astragalus. This surface may be compressed into a straight line or even decompressed so that there is a reverse of the normal angulation. This angle has been described by Boehler as the "tuber angle."[1] In the normal bone, if a line is drawn from the posterior-superior tip of the os calcis to its most superior point where it articulates with the astragalus, and if a second line is drawn from this point forward to the anterior-superior tip of the bone where it articulates with the cuboid, the angle produced by these two intersecting lines is normally one of 35°. Obviously, unless this angle is restored there is bound to be a shortening of the extremity equal to the loss in angulation.

Symptoms

SWELLING: A rapid, diffuse swelling involving the entire foot will be noted, beginning almost immediately following the injury and in a few hours reaches extensive proportions. Because of this extensive, rapidly developing swelling, in the opinion of many, it is thought to be better policy to delay treatment and resort to elevation and rest for a period of a week or ten days. In the more severe cases, seen late, we are inclined to agree with those who advocate a delay in beginning treatment.

ECCHYMOSIS: Early wide-spreading ecchymosis involving the heel and the instep is to be expected, and in fact, an area of ecchymosis along the lateral margins of the heel would lead one to suspect fracture.

DEFORMITY: The most evident deformity is that of a flattening out of the longitudinal arch. In certain extreme cases seen shortly after the accident, the foot appeared not only without an arch, but actually as though the toes and tarsal bones had been turned upward and the most dependent portion of the foot appeared to be where the arch of the foot would normally exist.

DISABILITY: In Type 1 fractures, or the intra-articular variety, a total inability to bear weight is evident. In certain of the minor chip fractures, the patient was able to walk so well that a fracture was hardly to be expected.

POINT TENDERNESS: Point tenderness where the main fracture line has completely extended across the bone usually at the juncture of the posterior 2/3 and the anterior 1/3, one might be able to map out a line of acute tenderness. However, the entire foot is usually so tender as to make a localized examination almost impossible and any motion of the ankle joint or even of the toes is exceedingly painful. Crepitus and false motion, in our experience, are not to be expected.

MEASUREMENTS: It is usually impossible by means of measurements to ascertain the degree of shortening of the foot or to determine by measurements any shortening of the affected extremity.

X-RAY EXAMINATION: The importance of a special exposure made to visualize the os calcis in those cases in which there has been a longitudinal fracture involving either the external or internal borders of the bone might well be overlooked in the usual anteroposterior and lateral views. By

placing the foot on the x-ray facet with the ankle in as acute dorsal flexion as is permissible and then shooting directly downward on the posterior portion of the os calcis, the posterior portion and perhaps more than half of the bone can be clearly visualized.

One should be familiar with the anomalies of the os calcis before interpreting a radiogram. At birth all of the bones are cartilagenous except for a small area of ossification in the center. There are secondary centers with an epiphysis for the back of the bone and a posterior plantar tubercle. This tubercle unites with the os calcis at about the 17th or 18th year. Frequently, a separation of this tubercle prior to its fusion is interpreted as being a fracture of this process. Occasionally, the only lesion of the bone may be a fracture of this process which is in close proximity to the posterior margin of the tibio-astragalo joint. Rarely, the posterior end of the sustentaculum is a separate piece of bone. A fusion between the os calcis and the scaphoid area, the os calcis and the astragalus may be encountered.

TREATMENT: The treatment of Type 2, non-displaced extra-articular lesions, would consist solely of affording the proper immobilization and protection of the foot. This could be accomplished by a circular plaster of Paris cast extending from below the knee to the toes, moulded so as to preserve the normal arch of the foot and to fix the ankle at a right angle with the foot slightly inverted. Such a cast should be worn for a period of perhaps four weeks, following this with a carefully fitted, substantial shoe which could be laced above the ankle, then weight-bearing might be undertaken. The importance of having the proper shoe cannot be over-emphasized in all cases which have been previously immobilized.

Those cases in which the greatest displacement of fragments is due to the lateral widening or squashing of the bone, require some form of compression treatment. For a number of years, this type of injury was treated by means of an attempt to mould the bones into shape by pounding upon them with a suitable mallet. This procedure is still commonly used by many as the only form of treatment for fracture of this bone. (Cotton and Wilson[3] have inserted the steel sound over the superior surface of the os calcis anterior to the tendo-Achilles, pulling downward and remodeling the bone. After reduction, they advise impacting the fragments by striking the bone several sharp blows with the mallet).

In the more severe types involving the sub-astragaloid joint, an arthrodesis in this joint with a remodeling of the os calcis is sometimes resorted to.[4]

The treatment advocated by Boehler[1] at the present time has become rather largely accepted. This consists of powerful skeletal traction applied to the posterior fragment of the os calcis by means of the introduction of a Kirschner wire. In order that sufficient traction may be made by means of the Boehler frame designed for the treatment of this condition, a second Kirschner wire is passed through the tibia and attached to the upper portion of the frame. After the shortening has been corrected by overcoming the impaction and the tuber angulation restored, the lateral displacement is then treated by means of a Boehler clamp which crushes the fragments together at the time they are held in the frame by the pull of the Kirschner wire.

By this method, all three of the main pathological displacements may be corrected at a single sitting. With the wires in place and the traction maintained, an x-ray picture is taken, and if reduction has been obtained a plaster of Paris cast is applied, extending from the toes to below the knee. The wires should be allowed to remain in place and are incorporated in the cast in order to prevent displacement. If the reduction is not satisfactory, as revealed by x-ray examination, the process may be repeated until a satisfactory position is obtained. In the Boehler method, the original cast should be allowed to remain over a period of three to five weeks. The pins are then removed and a cast applied with a walking stirrup. This is used for from six to nine weeks.

Still another method is that of directly exposing the end surface of the bone in order to do an open correction of displaced fragments. We were privileged to see only one such open reduction in a case operated upon by Dr. John J. Moorhead. Because of the cancellus nature of the bone and the severe comminution, various writers have advised against attempting open reduction.

AFTER CARE: Physiotherapy is important after the preliminary replacement and immobilization therapy. Its objectives are mobilization (of the ankle, i.e., the tibio-astragaloid joints and the tarsal joints, particularly the astragalo calcaneal joint), and reduction of edema and soft tissue induration.

In our experience the whirlpool bath has been most efficacious in accomplishing the latter results, probably because it produces vigorous massage simultaneously with a stimulation of circulation by means of heat. Active motion is more beneficial than passive motion with cooperative patients, because the patient ceases the motion upon the appearance of severe pain, thereby preventing the occurrence of excessive tearing of adhesions, which would produce further induration and more adhesions. The patient is instructed to make all motions of the foot, plantar and dorsi-flexion, inversion and eversion 20 times a day, forcing the motion until pain is experienced. He is told to attempt a greater degree of motion daily, and with an intelligent and interested patient the results are gratifying.

If the patient is not capable of carrying out this treatment, passive motion must be undertaken following each treatment. It is important that these motions be gentle in the beginning and gradually increased.

The various physiotherapeutic treatments are continued until no improvement has been noticed for a reasonable length of time, usually several weeks.

RESULTS: A considerable defect in function of the foot usually results from fracture. Cotton is of the opinion that in over 50% of the cases permanant disability occurs.[2] Magnuson, in reporting on cases at the Illinois Accident Board, describes an ultimate loss of 30 to 75%. It has been our practice in cases of intra-articular fracture to set up an immediate reserve of 50% of the foot.

A loss of plantar or dorsal flexion of the ankle joint is equal to one-half of the foot, and when one considers the frequency of persistent swelling, brawny induration and arthritic changes in adjoining tarsal bones with loss of lateral mobility, it is readily seen that a permanent defect of 60 to 70% may result.

Report of Complicated Case

STATUS: Male, white, 48 years. Well-developed, under-nourished.

HISTORY: One hour before admission patient fell 15 feet in elevator shaft, landing on his feet. Brought directly to hospital.

INITIAL PHYSICAL EXAMINATION: Patient appears to be in excruciating pain, lying on a stretcher with his knees flexed on his abdomen and his ankles extended. Any attempt to move knees or ankles increases the pain. Feet appear flattened, heels broadened. There is marked swelling about the heels and exquisite tenderness over the ossa calces. X-rays, lateral and axial views, reveal bilateral fracture with typical shortening, diminished tuber-joint angles and widening (Fig. 1). Comminution is extreme.

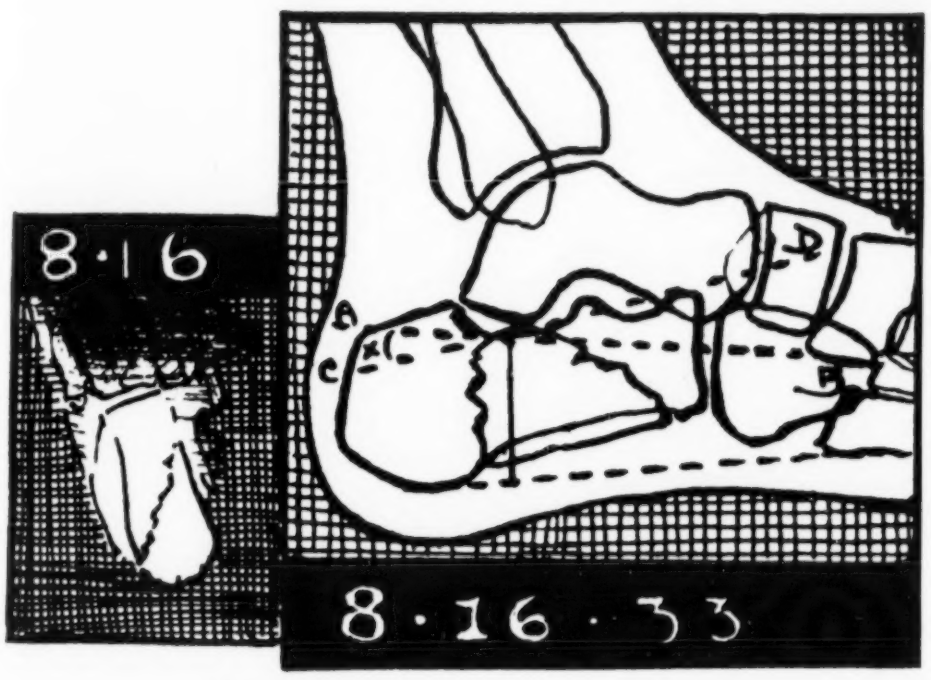


Fig. 1. X-Rays Before Reduction

OPERATION: Four hours after injury; spinal anesthesia; the tibia was transfixed with a Kirschner wire four fingers' breadth above the ankle joint, and the posterior upper corner of the os calcis with a second wire. The extremity was then placed in a Boehler frame and screw traction was made, first in the longitudinal axis of the os calcis and then in the longitudinal axis of the leg (Fig. 2). After the shortening had been corrected and the tuber-joint angles restored, the special moulding clamp designed by Boehler was applied along the lateral surfaces of the os calcis. Maintaining the traction, the clamp was turned down until the widening of the bone was corrected and the normal curves of the heel were apparent. The clamp was then removed, and with the traction unaltered a plaster of Paris casing was applied, extending from the toes to the knee. The Kirschner wires were incorporated in the casing. Small metal clamps snugly fitted to the wires and placed immediately adjacent to the casing prevented any change in the tension of the wires after the spreaders had been removed.

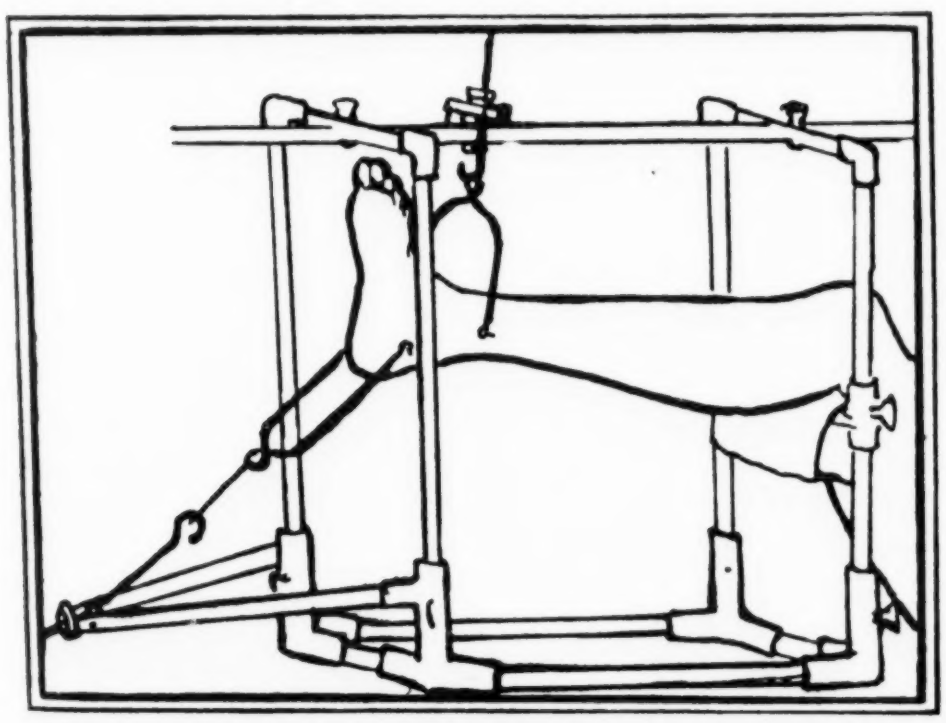


Fig. 2. Leg in Boehler Frame

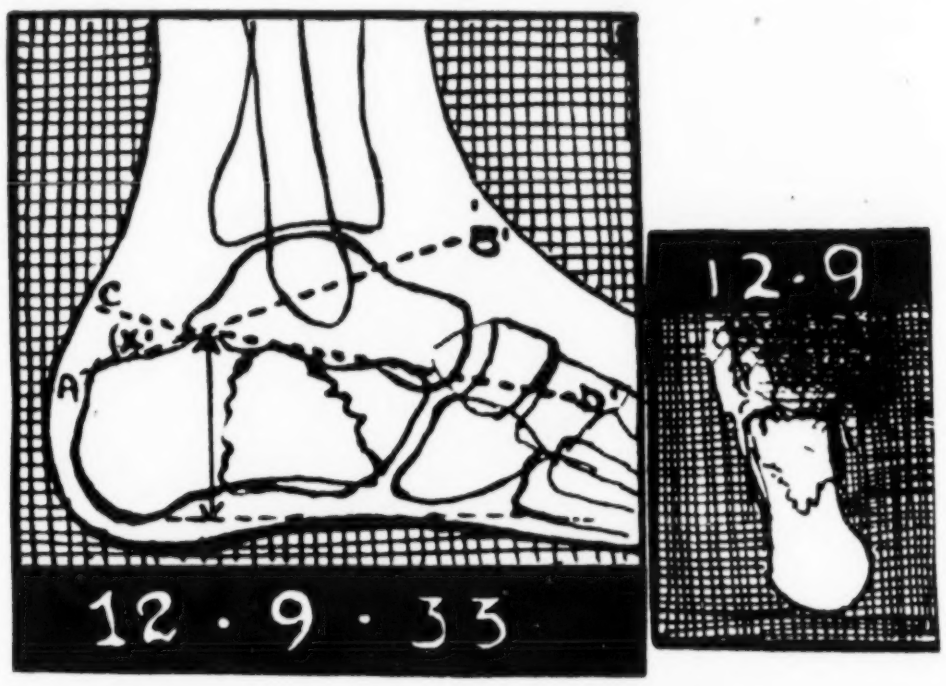


Fig. 3. X-Rays After Reduction

The same procedure was followed in treating the other foot.

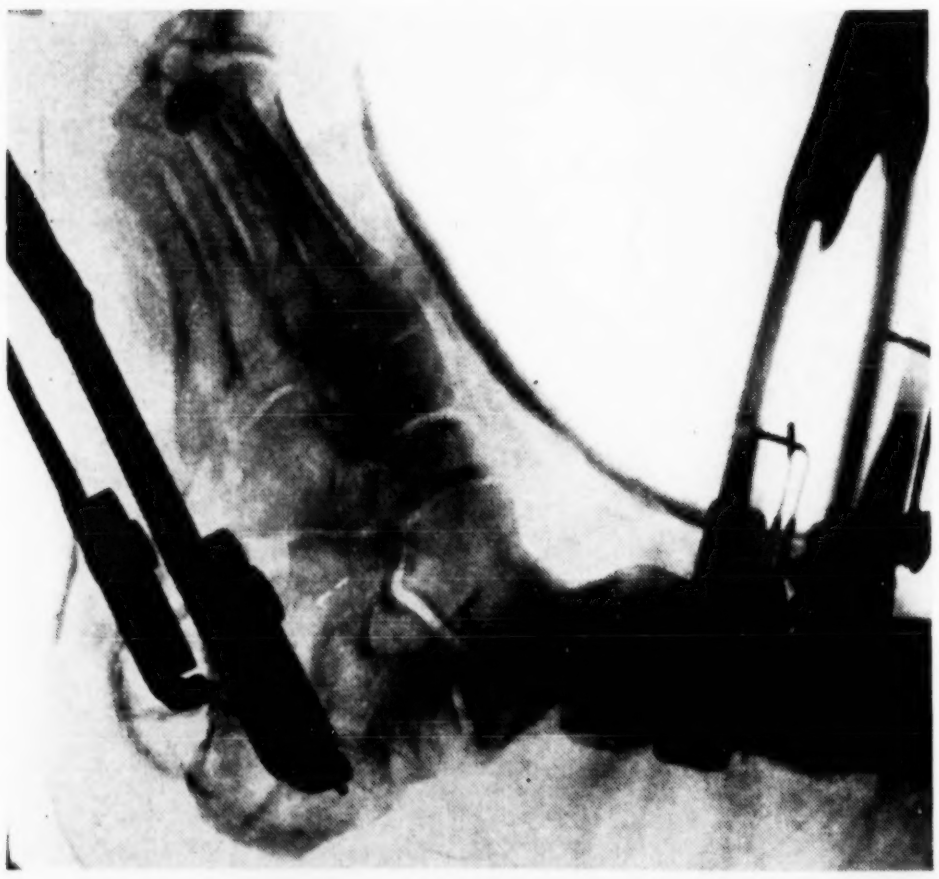
POSTOPERATIVE COURSE: Because of the swelling of the feet it became necessary to split both casings anteriorly throughout the entire length. X-rays revealed a correction of the widening and an improvement, but not a complete restoration in the tuber-joint angles. So the above procedure was repeated (Fig. 3). The Kirschner wires were removed on the left side at the end of three weeks and the cast removed on the sixtieth day (8½ weeks). A posterior splint was then applied and this was discontinued on the eightieth day (11½ weeks). At this time the foot was of normal length, the longitudinal arch well maintained and no widening of the heel could be detected. Weight-bearing was allowed on the 84th day. Massage and exercise of the left foot, ankle and leg were continued until the date of discharge. At this time examination revealed a slight loss of dorsal and plantar flexion. Aside from this there was no remaining disability.

On the 23rd day a discharge developed about the wire which had been driven through the right os calcis, and the patient complained of considerable pain. On the 27th day the pain had increased and the temperature had risen to 104°. The wires and casing were, therefore, removed. Wet dressings were applied. The temperature subsided, but a necrosis of an area of skin on the inner surface of the heel took place. On the 35th day the temperature was normal and the necrotic tissue had begun to separate. Forty-seven days after operation x-rays showed a rarefying osteitis of the os calcis. On the 84th day x-rays showed good callus formation and no further extension of the osteitis. At 113 days after operation there was no discharge from the wound on the inner side, and the patient was allowed weight-bearing on this foot. On the 123rd day, under local anesthesia, an area about the size of a dime which had not closed was

sutured. Satisfactory union was obtained. X-rays on discharge showed that there had been some loss of the tuber-joint angle as compared with the original exposures after reduction.

The foregoing complete case report is included in the paper in order to show the complications which might arise in the course of treatment. Unfortunately, the final end results in both the right and left foot are still undetermined. The patient was able to resume light work on April 15, 1935, and his maximum improvement was reached in June of the same year.

X-Ray Before Reduction



X-Ray After Reduction: Slight Over-Correction

Where there has been a severe lesion in a severe bilateral fracture, one must bear in mind the possibility of a permanent total disability in an uncorrected case.

The adjacent photographs are of a case with obliteration of the tuber angle, in which the angle was, if anything, overly corrected as shown in the second photograph. In spite of this over-correction, the case received only a permanent loss of 20% of the foot.

The following tables illustrate the results of our series. All of the fractures were caused by falls, the distance varying from 30 feet to five feet. There were no females in the series.

Number	Age	Intra-Articular	Extra Articular	Comminuted	Tuber Angle Depressed	Foreshortening
589901	54	*		*		
591578	30	*		*	*	
C.S.	48-L	*		*	*	
C.S.	48-R	*		*	*	
516114	42		*			
659966		*		*	*	*
516467	61-L	*				
516467	61-R	*			*	
591830	41	*		*	*	
589592	57	*		*	*	
518992	44	*		*		
515856	49	*				*
585370	60		*			
515844		*				
518809			*			
714629			*			
Totals		12	4	8	7	2

Table I. Pathology.

Number	Immobilization	Whirlpool Bath	Physiotherapy	Traction
589901	*		*	
591578			*	Pierson extension (x)
C.S.				Boehler Method
C.S.				Boehler Method
516114	*		*	
659966	*			Boehler Method
516467	*	*	*	Circular Plaster of Paris Cast
516467		*	*	Circular Plaster of Paris Cast
591830	*		*	Circular Plaster of Paris Cast
589592	*		*	Circular Plaster of Paris Cast
518992	*	*	*	Circular Plaster of Paris Cast
515856	*	*	*	Circular Plaster of Paris Cast
585370	*		*	Circular Plaster of Paris Cast
515844	*	*	*	Circular Plaster of Paris Cast
518809	*		*	Circular Plaster of Paris Cast
714629	Partial		*	Posterior Plaster Splint
Totals	12	5	13	

(x) Plantar flexion and traction.

Table II. Treatment.

Number	Recumbent Period	Period of Immobilization	Period of Total Disability	Period of Partial Disability
589901	3 weeks	5 weeks	8 weeks	12 weeks
591578	16 weeks	4 weeks	20 weeks	4 weeks
C.S.	32 weeks	8 weeks	?	?
C.S.	32 weeks	8 weeks	?	?
516114	5 weeks	9 weeks	14 weeks	10 weeks
659966	2 weeks	8 weeks	20 weeks	4 weeks
516467	13 weeks	4 weeks	28 weeks	4 weeks
516467	13 weeks		28 weeks	4 weeks
591830	3 weeks	12 weeks	18 weeks	2 weeks
589592	none	4 weeks	12 weeks	8 weeks
518992	none	6 weeks	24 weeks	4 weeks
515856	7 weeks	8 weeks	12 weeks	72 weeks
585370	2 weeks	4 weeks	16 weeks	4 weeks
515844	2 weeks	4 weeks	4 weeks	24 weeks
518809	3 weeks	12 weeks	20 weeks	4 weeks
714629	none	3 weeks	7 weeks	2 weeks
Average	8 weeks	6 weeks	15 weeks	10 weeks

Table III. Disability Period.

Number	Depression of Tuber Angle		Arthritis	Foot Fore-shortening	Lateral Spreading		Spur Formation
589901	*						
591578	*						*
C.S.	*			*	*		
C.S.	*			*	*		
516114			Healing with no evidence of injury				
659966				*			*
516467	*				*		
516467	*				*		
591830	*				*		*
589592	*		Osteoporosis		*		*
518992			Osteoporosis				*
515856	*						*
585370			No further X-Rays taken				
515844							
518809			No deformity				
714629			Fracture line obliterated				
Totals	9			4	6		6

Table IV. Final Pathology.

Number	Defect in Flexion	Defect in Lateral Motion	Thickening	Permanent Defect
589901	*	*	*	Comm. 45%
591578	*			20%
C.S.	*	*	*	Still undetermined
C.S.	*	*	*	Still undetermined
516114				None
659966-(x)	*	*	*	20%
516647	*	*		20%
516467	*	*	*	30%
591830	*	*	*	Comm. 45%
589592	*	*	*	Comm. 45%
518992	*	*	*	40%
515856	*	*	*	40%
585370	*	*		Comm. 20%
515844	*	*	*	25%
518809		Normal		None
714629				None
Totals	13	12	10	Average 25%

(x) See X-Ray.

Table V. Permanency.

Conclusion

AN ATTEMPT should always be made to obtain reduction.

2. Boehler's method is perhaps the most satisfactory means of reduction.

3. Prolonged physiotherapy is an important part of the treatment, and the whirlpool bath appears to be the best agent.

4. Fractures do not necessarily produce a permanent defect.

5. A permanent defect of more than 50% is not to be expected.

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Occupational Disease Compensation

Data Indicative of Cost, for Occupational Diseases in General, and of Silicosis, Asbestosis and Dust Diseases in Particular

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Massachusetts Experience

ALTHOUGH the Massachusetts Workmen's Compensation Law has from its inception—it became effective July 1, 1912—literally covered all "injuries" arising out of the employment, it was not until the decision, in 1929, of the Supreme Judicial Court, in *Sullivan's Case*, 265 Mass. 497, that pneumoconioses (including silicosis) were held to be covered. Until then the cost of the few cases of occupational diseases theretofore held to be compensable was too low to affect the rates materially. But that case, and *Fabrizio's Case*, 274 Mass. 352, decided several years later, caused a widespread claim consciousness requiring modifications in rates to meet an acceleration, both actual and prospective, of occupational disease costs — most immediately in the rates for stone cutting and foundry hazards. The following is a rough outline of the subsequent development of the rates for such occupations to October, 1935:

Stone Cutting

IN THE Manual the risks in question originally came under classification:

"1803. Stone Cutting and Polishing (N. O. C.) excluding quarrying."

As of March 1, 1934, that classification was discontinued and the following was substituted:

"1808. Stone Cutting or Polishing—Granite—including Drivers, Chauffeurs and their Helpers. (Quarrying to be separately rated)."

Under Classification 1803 a rate of $4.77 per $100 (covering all "injuries" under the law) was in effect from December 31, 1928, to June 1, 1931, and, though omitted from the Manual after the latter date because of application for official approval of a higher rate, continued in effect for about a year longer. However, in the meantime, various carriers requested and received approval of a $10 rate for many risks. Later, because of wage reductions, a $12 rate was approved for a period beginning June, 1932. But only one company would write the insurance at such rate, and it discontinued November 1, 1932, because of unwillingness of its reinsurer to continue.

Thereupon, as a result of conferences between the Insurance Commissioner and actuaries representing the Rating and Inspection Bureau and leading carriers, in November, 1932, it was recommended to establish a rate for this classification of $5 per $100 payroll, with a "Supplementary Occupational Disease" rate of $300 per employee per year ($25 per month for any employee on the payroll during all or any portion of any calendar month). This rate was not approved until over a

year later, to take effect December 1, 1933. In the meantime, insurance of risks in this classification was almost entirely suspended.

The $300 per capita rate was based on the fact that the experience under Classification 1803 for the policy years 1926 to 1930 inclusive disclosed a total of 92 pneumoconiosis cases, with an incurred loss of $288,075, the average claim cost being $3,131. It was estimated that many employees then in the industry would within the next 10-year period develop the disease, making it necessary to collect over that period the sum of $3,000 per man. Hence the necessity for the supplementary occupational disease rate of $300 per year or $25 per month of employment exposure.

However, the Supplementary Occupational Disease rate (of $300 per employee) may be reduced 40% provided that specified conditions relative to the health of employees, dust suppression and personal protection, are continuously effective; and may be entirely removed if more stringent conditions be maintained. On the other hand there are special conditions applicable to the writing of risks in this classification—relative to inspections, approval by Rating Bureau, audits, experience rating, commissions and engineering requirements.

The rating provisions above outlined now apply to Classification 1808 (which on March 1, 1934, was substituted for Classification 1803, as explained above).

While these rating provisions were developing, the payrolls in the stone cutting industry in Massachusetts were shrinking, as per the following table (furnished by the Massachusetts Rating and Inspection Bureau):

Policy Year	Payroll
1929	$3,033,200
1930	2,657,600
1931	2,046,100
1932	786,800
1933	421,400

Of the payroll for 1933, $342,248, being 81%, was represented by one large risk which is not insured. These figures indicate that the cost of occupational disease coverage is either causing unemployment or causing men to continue at work without compensation insurance protection, or both.

Foundry Hazards

IN OCTOBER, 1933, the Massachusetts Rating and Inspection Bureau submitted for official approval a Supplementary Occupational Disease rate of $4.00 per $100 of payroll to be applicable to all employees exposed to a foundry hazard. This rate was computed upon Massachusetts' experience with silicosis losses in all classifications and upon silicosis claim frequency from foundry hazards in other jurisdictions, the Massachusetts experience with foundry losses being yet too brief and inadequate to serve by itself as a basis for rate making. However, such proposed rate was not approved, and, instead, a Supplementary Occupational Disease rate of $2.00 per $100 on the payroll of all employees exposed to a foundry hazard in any risk, howsoever classified, was approved to take effect December 1, 1933, and is still in force. This premium is in addition to the normal premium for the classification.

The situation in Massachusetts in regard to insurance of foundry hazards is complicated by emotions aroused by the so-called Glenwood Range Company case. In that case, a carrier which had insured the range company, cancelled its policy because of unfavorable experience. Thereupon another carrier took the risk, but, first, some 42 employees were discharged because reported, upon medical examination, to be already affected with silicosis. Generally these men were not disabled, and a violent public agitation was aroused in their behalf. In consequence they were nearly all taken back eventually, the retiring carrier compensated them for their lost time, and a third carrier took the risk upon being reinsured by a pool of other carriers. Although experience is yet too brief to demonstrate conclusions, it indicates that the $2.00 rate is inadequate—especially in view of the fact that, since such rate was established, the period of compensation for permanent total disability has been lengthened (by Chapter 364, Acts of 1935) by the addition of a life pension after the termination of the former limit of 500 weeks.

Silicosis and Asbestosis

British Experience

SUCH British experience as is available is difficult to analyze and explain without a thorough knowledge of the British compensation law—that part of which relating specifically to this subject consists of many complex provisions in each of six different "schemes."

The schemes do not cover all industries broadly, but only those industries enumerated in some one of five trade schemes. (The sixth scheme relates to "Medical Arrangements," which apply to all the other schemes). These schemes are all relatively new, and their collective scope has been much enlarged in very recent years. Consequently the experience is not broad and has been too brief to be definitely instructive.

Under each of two of the trade schemes, insurance is monopolized by a compulsory Trade Fund. Under the other three trade schemes, stock companies and mutuals provide the insurance, and many establishments "self-insure."

The risk insured against is practically threefold: (1) of primary liability for disease contracted during the term of the policy; (2) of liability to contribute pro rata to the cost of compensation to ex-employees; (3) of liability for compensation to employees "suspended" on *first* official periodical medical examination after the carrier goes on the risk. The stock companies cover these risks —one, two or all — variously; but their quoted rates, it seems, generally apply only to the first coverage and there are extra charges for the other two—the charge for coverage of the third risk being commonly an extra annual premium.

The charges for insurance—which are the only indicia of loss cost available—are rated variously: On total payroll (with exclusions); on wages of named employees or of employees engaged in specified processes; per capita; per grindstone raced; per millstone dressed; etc., etc.

Note that the rates in question are for insurance of compensation only for silicosis *or* asbestosis (including cases complicated with tuberculosis) and are additional to the rates for accidents and other occupational diseases.

In the "Sandstone Industries Scheme" the rates assessed by the Trade Fund for 1935 are reported to be as follows, in percentage of wages: Grade A, 4.16%; Grade B, 2.08%; Grade C, 1.04%.

In the "Refractories Industries Scheme," the Trade Fund assesses a uniform, "flat" rate for all establishments alike. That rate is reported to have been recently increased from 5% to 6.25% of wages.

The industry subject to the "Asbestos Industry Scheme" is largely controlled by one large organization which is a "self-insurer" and does not report its experience. The stock company rates for risks subject to this scheme vary from 7½% to 10%, where strict precautions are taken, with a special rate of 12.5% for the making or repairing of asbestos mattresses.

The following are some illustrative rates reported to be charged by the stock companies for occupations under the "Various Industries Scheme" and the "Metal Grinding Industries Scheme"—in percentage of wages unless otherwise stated:

Brick manufacturer	.05
Potteries—China)	6.25
Potteries—Earthenware)	3.125
Plus £1 per capita to cover suspension on first medical examination.	
Builder—Stone masons only	7.5
Plus £7.10 per capita for coverage of named ex-employees or an additional annual premium for coverage of all ex-employees.	
Public works—dressing pavement stones or curbs	£10 per capita
Racing grindstones—per grindstone raced	£1
Corn mill—per pair of stones dressed	10s
Manufacturing and packing scouring powder	5%-10%
Metal grinding	6%-10%
Foundries and metal works (general)	2%

The inadequacy of the British experience needs to be emphasized. Asbestosis became compensable only in 1931; and the same is true of silicosis in coal mining. Experience in the coal mining industry is especially significant in this respect. There are three or more large coal mining areas in Great Britain. In one area, South Wales, the cases of silicosis certified have been increased progressively as follows: 1931, 61; 1932, 161; 1933, 230. In the other areas there have yet been almost no cases. There is no known reason for this increase in one area and absence of cases in the other areas, except increasing claim consciousness in the first area and unawakened claim consciousness in the others.

In connection with the above-cited rates for insurance of compensation for silicosis and asbestosis, the benefits under the British Workmen's Compensation Acts should be considered. Roughly they are as follows:

For incapacity: 50% of average weekly wages, or of the resulting wage loss, maximum 30s. per week, during incapacity—subject to commutation by agreement.

For fatal injuries: lump sums, varying according to number and relationship of dependents; maximum for widow alone, £300; maximum for widow and dependents under 15 years of age, £600.

Medical benefits: none, i.e., the employer or insurer may voluntarily provide medical, surgical or hospital treatment or care but neither is under any obligation to do so.

Silicosis

New South Wales Experience

IN NEW South Wales there are two "schemes" for compensation for diseases caused by silica dust. For one of these schemes — "Workmen's Compensation (Silicosis) Scheme No. 1"—the cost experience has been distinctly and adequately reported.

That scheme applies to stonemasons, quarrymen, rock choppers and sewer miners in Cumberland County. The compensation is payable out of a public fund, maintained by levies upon employers and substantial subventions by the state. According to the figures published in the "Eighth Annual Report of the Worker's Compensation Commission," the losses incured, plus expenses of administration, from the inception of the scheme in 1927 to June 30, 1934, amounted to about 10% of payrolls in the occupations covered. This cost, it should be emphasized, was for compensation for silicosis alone, compensation for accidental injuries and other occupational diseases being a separate matter.

In this connection, it should be further noted that the scale of benefits under this scheme is not abnormal, the maximum total payments for incapacity, for illustration, being limited to £750.

Occupational Disease Coverage

North Carolina

THE following table gives the present manual rates for workmen's compensation insurance in North Carolina, for a few typical classifications in which there are silicosis or asbestosis hazards, with the total rate, and the total occupational disease element, and the specific silicosis or asbestosis element in the rate, stated separately:

Code	Classification	Total Rate	Total O.D. Element	Asbestosis or Silicosis Element
1605	Rock excavation	$11.35	$1.34	$1.32
1852	Asbestos goods mfg.	5.48	3.00	2.98
3081	Iron foundries—N.O.C.	5.21	3.00	2.98
3085	Foundries—non-ferrous metals—N.O.C.	4.62	3.04	2.98
1164	Mining—not coal—with shafts, tunnels, or drifts	10.88	3.00	2.98
1803	Stone cutting	5.62	3.00	2.98
4000	Sand and gravel	6.55	.27	.29

In classification 3085, the slightly higher total occupational disease element is due to the fact that there is some lead as well as silicosis hazard.

In each of the foregoing classifications, it is provided that where the occupational disease hazard of the risk is abnormal, an addition to the manual rate may be charged, subject to the approval of the Compensation Inspection and Rating Bureau of North Carolina.

It should be noted that these rates are highly tentative or speculative, being based upon estimates in advance of experience. They are, however, predicated upon the specific provisions of Section 50½ of the North Carolina Workmen's Compensation Act, as added by amendment effective March 26, 1935, which provisions clearly define the diseases to be deemed "occupational" and specially regulate the liability to compensate for silicosis or asbestosis.

That amendment followed a decision by the

Supreme Court of North Carolina, in *McNeely* v. *Carolina Asbestos Co.*, May 23, 1934, wherein it was decided that an occupational disease (asbestosis) contracted unexpectedly and gradually during many months of exposure, if due to the employer's failure to provide means of prevention, is an injury "by accident" and, as such, was compensable under the Workmen's Compensation Act as it then read—which decision injected elements of uncertainty into the law that rendered the hazards of occupational diseases, particularly of silicosis and asbestosis, often uninsurable at practicable rates. At the time of this decision, the manual rates then in effect, for the classifications above given, were as follows:

Code	Classification	Total Rate	O.D. Element
1605	Rock excavation	$8.95	$ .45
1852	Asbestos goods mfg.	2.86	.53
3081	Iron foundries—N.O.C.	2.84	.40
3085	Foundries—non-ferrous metals —N.O.C.	2.18	.40
1164	Mining—not coal—with shafts, tunnels or drifts	7.75	.40
1803	Stone cutting	3.29	.90
4000	Sand and gravel	5.47	.10

With reference to the occupational disease element in these earlier rates, it needs to be explained that, although "occupational diseases" as such were not then compensable, yet there were risks, i.e., chances, of liability for occupational diseases at common law, which might be covered by the policies, and of some cases of occupational diseases being compensable because arising "by accident."

The McNeely case, above referred to, so construed the phrase "by accident" as to magnify the occupational disease risk under the compensation law tremendously, thereby rendering the rates then in effect grossly inadequate for all classifications with asbestosis, silicosis or other serious occupational disease hazards.

Dust Disease Coverage

New York

IN NEW YORK, rates and charges for dust disease coverage have been approved, effective September 1, 1935. These rates cover the dust disease hazard only, and are additional to the manual rates for coverage of accidental injuries and all other occupational diseases.

Since there are two methods of rating the dust disease risks, it is necessary to show two sets of rates for this coverage. The two methods are:

RATING PLAN I: Under Rating Plan I, the risk is charged, in addition to the general workmen's compensation rate, a rate per $100 of payroll on those classifications in which the dust hazard is present, which rate is designed to provide premium to take care of dust disease losses only. In addition to these rates per $100 of payroll, the assured is charged $300 per claim for each claim for disability lasting four months or longer, or for death, resulting from injury to the respiratory tract. These rates for the dust disease hazard may be eliminated, reduced or increased, subject to the approval of the Compensation Insurance Rating Board, where, in a particular risk, the processes or products causing the hazard are non-existent or present a subnormal or abnormal hazard.

RATING PLAN II: Under Rating Plan II, there is charged for the dust disease hazard a rate per $100 of payroll, much lower than the rate under Plan I, but, in addition, a per capita deposit per employee is required. Under this Plan the assured is required to reimburse the carrier for 6/7 of all losses and allocated loss expenses arising as a result of dust disease claims during the first year, subject, however, to a maximum charge to the employer of $6,214 per claim. It is contemplated that in each of the following six years after the first the proportion of the losses to be borne by the carrier shall increase by 1/7, while the proportion borne by the employer shall decrease at

Code Nos.		Rating Plan I Per $100 payroll	Rating Plan II Per $100 payroll	Rating Plan II Per capita
1164	Mining—not coal—with shafts	$ 4.63	$1.88	$ 64
1165	Mining—surface	2.89	1.18	40
1438	Smelting, etc.—metals N.O.C.	2.89	1.18	40
1439	Smelting—by electrical process	1.74	.71	24
1604-5; 1624	Quarries, rock excavation, etc.	5.21	2.12	72
1710	Stone crushing, no quarrying	5.79	2.35	80
1741	Flint or spar grinding	11.58	4.70	160
1747-8	Emery works; abrasive wheel mfg.	3.47	1.41	48
1809	Stone cutting or polishing—marble and limestone only	1.16	.47	16
1810	Stone cutting or polishing—all others	10.42	4.23	144
1852	Asbestos goods mfg.	6.95	2.82	96
1852	Asbestos goods mfg.—moulded products only	3.47	1.41	48
3081-2; 3085	Foundries—iron—steel castings—non-ferrous metals	4.63	1.88	64
....	Foundry workers only (in various classifications)	4.63	1.88	64
3091	Enameled ware (iron) mfg.	5.21	2.12	72
3122; 3126	Cutler mfg.; tool mfg.	2.32	.94	32
3169; 3883	Stove mfg.; car wheel mfg.	4.63	1.88	64
4000	Sand or gravel digging	1.16	.47	16
4021	Brick or clay products mfg.	2.89	1.18	40
4024	Refractory products mfg.	3.47	1.41	48
4053	Potteries—china or table ware	4.05	1.65	56
4061-2	Potteries—glazed or porcelain ware	3.47	1.41	48
4101-2; 1411-14	Glass and glassware mfg.	1.74	.71	24
5469	Cleaning, etc., outside of buildings	9.84	4.00	136
5508	Road construction—rock excavation	5.21	2.12	72
6251-2; 6254-60	Tunneling, shaft sinking, conduits, etc.	1.74	.71	24

New York — Rates and Charges, Effective September 1, 1935; Dust Occupational Disease Coverage Only

the same rate, so that after seven years the insurance carrier shall bear the entire loss. The per capita charge under this Plan is in the nature of an advance deposit guaranteeing that the employer will reimburse the carrier for his 6/7 or other proportion of the dust disease losses. In the event that this deposit is exhausted, the carrier may call upon the assured for additional deposits. As under Rating Plan I, the rates may, with the approval of the Compensation Insurance Rating Board, be removed, reduced or increased for a particular risk if the dust disease hazard is found to be non-existent, subnormal or abnormal.

In the table (on p. 182) are given the manual rates for this particular coverage, under each of the two plans, and the amounts of the additional deposits under Plan II, for some typical occupations, preceded by notations of the code numbers in the New York Manual of the classifications affected—for the benefit of those who may have such Manual available.

High though these rates may seem, their adequacy, under the present New York law, is generally doubted, with the consequence that the private insurance carriers are rejecting many risks, whereas the State Fund (which is not bound by manual rates) is exacting yet higher charges, especially for risks rejected by the companies.

As a consequence of these very high rates, and the inability of some industries to get any kind of insurance at a price that permits continuance of operations, many establishments are laying off workmen and either closing down or sending their hazardous work out of the state, and an insistent demand has arisen for drastic amendment of the law in so far as it relates to silicosis and other dust diseases. It is probable, therefore, that the 1936 session of the legislature may see important changes in the law and consequently in the insurance rates.

Nursing Service for Industry

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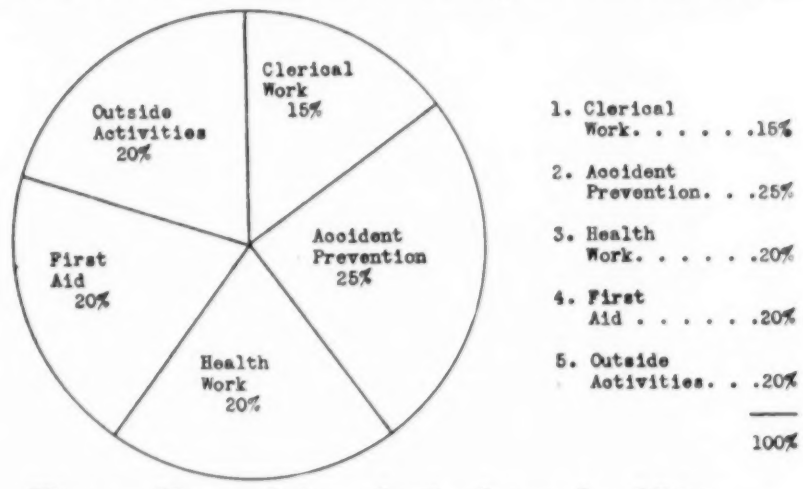
IT IS to industry's financial advantage to develop a more adequate industrial nursing service.* A nurse's talents contribute so directly to the humanizing of employer-employee relationships that even in moderate-sized plants her services are aiding industry to increase individual production through well set up industrial health programs.

"How large should a plant be before it is necessary to hire an industrial nurse?" "Are we of sufficient size to pay us for the additional expense incurred?" "Can we cut our insurance cost by hiring a nurse?" These and similar questions pertaining to nursing service in industry reach me daily. Very little thought has been given by the employer to the amount of good will which may be created through the employing of a nurse. This is due, no doubt, more to lack of knowledge than to indifference. One of the strongest arguments I have in favor of a nurse in industry is for that very purpose—the promotion of good will.

Let us go back to the first question: how large should the plant be? As to the size of the industry requiring a nursing service, any plant employing more than 200 persons could well profit by employing a registered nurse. This does not imply that in a plant of this size there would be a sufficient number of injuries to keep a nurse busy; rather, there should be fewer injuries because of the educational work done in the promotion of good health and in the prevention of accidents.

Time and money spent on prevention are far better business and give far better results than time and money spent on the care of injuries which have resulted from the lack of educational and safety activities. The hazards involved in the manufacturing of a product should, in a great measure, determine the advisability of a nurse in industry. Where the women employees exceed the men in number a nurse is invaluable, as women and young girls hesitate to go to the foreman or the plant superintendent with problems which are common to their sex alone. Their home problems, too, are many, and can frequently be simplified by discussion with a kindred spirit who understands them and respects their confidences.

Following is a chart to indicate the manner in which the cost of the nurse may be distributed:


Clerical Work 15%
Accident Prevention 25%
Health Work 20%
First Aid 20%
Outside Activities 20%
1. Clerical Work. 15%
2. Accident Prevention. . .25%
3. Health Work. 20%
4. First Aid 20%
5. Outside Activities. . .20%
100%

1. *Time allowed for clerical work*: 15%.

This may appear to be a large proportion of the total cost, but not when one considers that a record is to be kept of every injury reported and every ailment; and that the nurse keeps all the records of physical examinations and their follow-ups, and of all compensation cases, together with the records of the payments of claims. In addition, if there is a welfare committee, she serves as secretary of the safety committee. Likewise, if there is a group insurance policy covering the health of the employees she also is the logical person to take care of those records and the following up of the payments of those claims.

2. *Accident Prevention*: 25%.

A nurse has an unlimited opportunity to put forth an object lesson to the worker at the time when he reports an injury. He receives graciously the suggestion from one who, he feels, is personally interested in his welfare, and who is not thinking of him merely as an efficient person to turn out more work. He is the breadwinner of the family, and as such has a responsibility toward himself, his dependents, and the community. In my own experience in industry I have had many opportunities to encourage that pride in physical well being of the workman.

3. *Health Work*: 20%.

Lost time may be greatly diminished through the early recognition of diseases, occupational or otherwise.

The nurse is in a position to recognize early

* This is the first of three articles by Miss Johnson. The second will appear in *Industrial Medicine* for May, 1936.

symptoms of tuberculosis, and in recognizing them will take immediate steps to have the patient referred to his family physician, thereby eliminating the possibilities of infection to others in the plant. Education is then directed to the family of the tuberculous patient.

Dermatitis frequently causes much discomfort and lost time. It is often due to the careless handling of materials, and can be eliminated through the proper protective clothing, a change of mechanical operations, or a change of occupation.

4. *First Aid:* 20%.

Early care of minor injuries decreases the possibility of infection. Prompt reporting cannot be expected if first aid is not properly administered. Every injury requires careful follow-up. In all cases, proper first aid measures reduce suffering and place the patient in the physician's hands in a better condition to receive treatment.

5. *Outside Activities:* 20%.

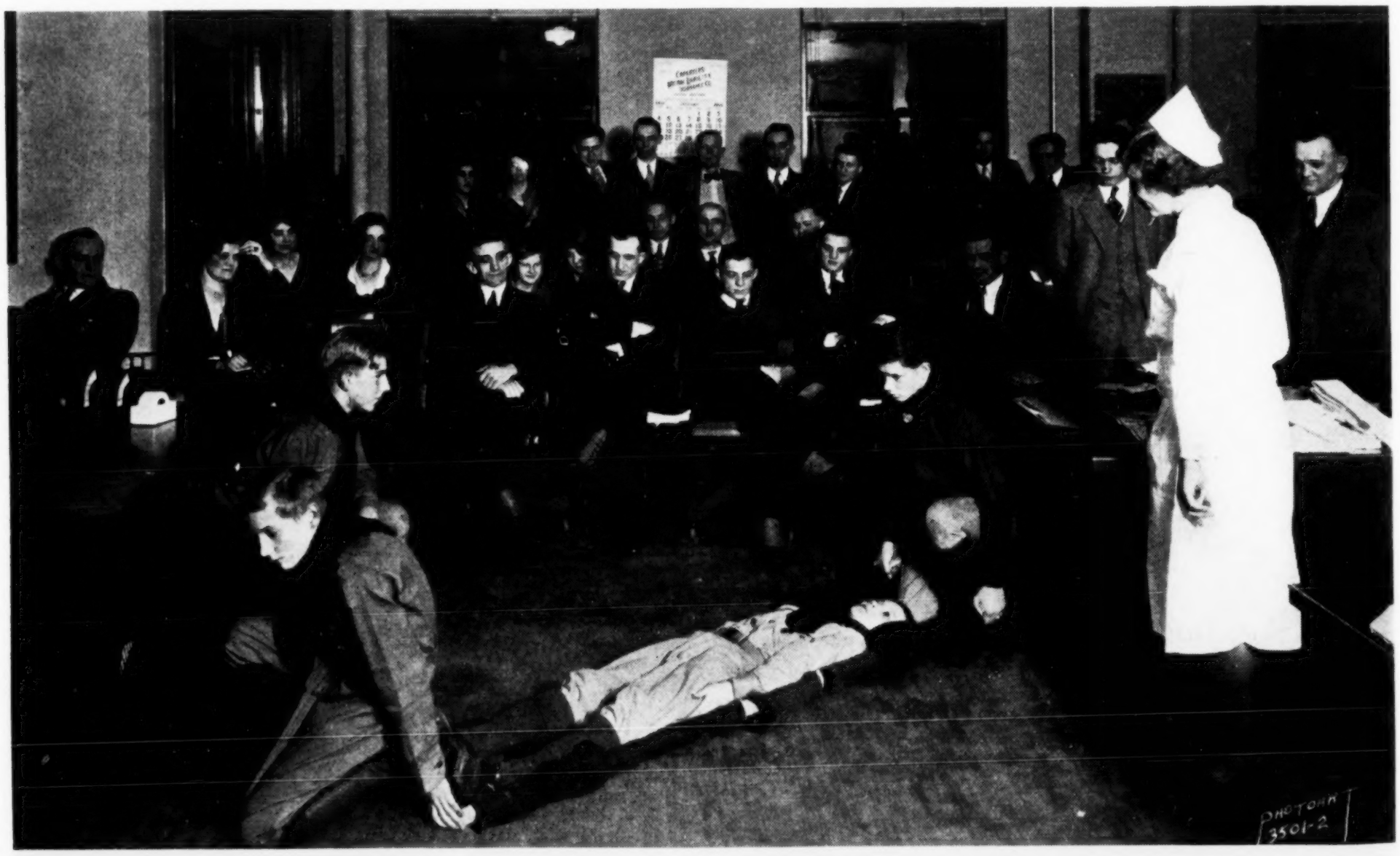
Contacts with community health and social agencies are important factors in a nurse's service in industry. Such contacts are especially important in the promoting of specific health programs, such as in connection with tuberculosis, heart disease, and social and mental hygiene. These services may be carried on as extensively as the resources of the plant permit.

One of the arguments against employing a nurse in industry is that her first aid room might be used as a place in which to waste time. This will depend entirely upon the nurse. An efficient, business-like, interested, and intelligent nurse will not allow anyone to use her place of work as a hang-out. She will see that all problems which are to be discussed with her are handled in a friendly and efficient manner, and will, under no circumstances, allow prolonged visiting. Her time will be taken up with so many matters of more importance that those persons who have come to waste time will soon learn that this is not the place for idle gossip. A well set up industrial health program will have a separate room which is quiet and which may be used as a place of rest in an emergency, and for an unusual illness.

Physical examinations may be called the keystone of industrial health work. They should be made by a well qualified physician. However, they should not be made with the idea of weeding out the unfit, but rather to promote safe and proper placement of the worker and as a stimulus for lessening turnover. These examinations may reveal many defects, but if these defects are not brought tactfully to the attention of the patient for correction, the examinations lose their true value. There is no one so well qualified to aid the patient in correcting these defects as the industrial nurse. She has learned of the home conditions of the worker and his financial responsibilities, and thus she may be of assistance in arranging a suitable budget. She knows, too, that there are many public agencies which may be of help. The family physician to whom the patient is referred will be pleased to work with the nurse and allow her to assist him in correcting his physical handicap.

Through the employment manager's office the nurse will assist in arranging ways and means for the payment of such medical bills as may be found necessary on account of illness or other disabilities. Corrective dental care may be the means of preventing an employee from having a long disability from an alleged or real back injury. Through corrected vision, a workman who has repeatedly been wasting materials, or who may have been on the verge of losing his job because of poor workmanship, may become a most capable employee.

A striking example of the value of these services is found in a small plant where employment of a nurse led to greater interest in safety activities



The Nurse as a Teacher

and, in consequence, cut down the lost time accidents from 67 per year to 38 per year over a period of four years. Compensation cases were cut down from 31 cases per year to 10, and days lost were cut down from 2,430 to 290. The severity rate was cut from 1.67 to .2025.

Fractures of the Pelvis

By PHILIP H. KREUSCHER, M.D., F.A.C.S.,
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FRACTURES of the pelvis are occasioned by great violence.* The force may be transmitted through the femora to the pelvis or through the spinal column upon the sacrum or the sacroiliac joints. Because of this mechanism of production the femur is often fractured, the head dislocated or even driven through the acetabulum into the pelvis. The spine may be fractured, the vertebrae compressed or the sacrum displaced or comminuted. Direct trauma in the antero-posterior plane or lateral compression of the pelvis causes almost any conceivable fracture or dislocation, provided the trauma is sufficiently severe. This is also especially true when the patient's pelvis is "rolled" between two resisting objects. In the front-to-back or back-to-front "squeeze" the injury is commonly to the rami and sacrum, while in the lateral compression the rami as well as the floor of the acetabulum and the ala of the ilium may be involved.

In the series of 125 cases reported by Noland and Conwell[1] five years ago there was the following anatomic classification of fractures:

Ala of the ilium	26
Crest of the ilium	9
Superior ramus of the pubis	52
Inferior ramus of the pubis	4
Inferior ramus of the ischium	38
Superior ramus of the ischium	3
Acetabulum	21
Separation of the symphysis	9
Definite sacroiliac separation	9
Isolated fracture of the ischial tuberosity	2
Double vertical fracture of the pelvis (Malgaigne)	8
Fracture of the sacrum with associated pelvic fracture	3

For the sake of simplicity we make the clinical division of these cases into two groups: (1) fractures of the pelvic bones without injury to the viscera, and (2) fractures of the bones of the pelvis associated with visceral lesions. The differentiation of these two groups is not always easy, nor is it always possible in the first hours after injury.

Every case of fracture of the pelvis is an acute emergency. A condition which carries with it a mortality of 16.2%, as seen from the Noland-Conwell second series, is one which commands the attention of every surgeon. Collected from both industrial and civil cases, this series of 185 cases represents a good cross-section of what one must be ready to face.

Although this is an acute emergency, rarely if ever is immediate surgical intervention indicated. Watchful waiting is the order of the day. After the patient's pelvis has been put at rest there should be a lot of watching but not always too much waiting.

The number and extent of fractures is not an index as to what has happened in the soft structures within the pelvic girdle. Often severe fractures and displacements cause no soft tissue injury at all; but, on the other hand, a lesser bone injury may cause serious damage to the pelvic or abdominal contents. The fact is that bladder and bowel injuries may occur without actual fracture or dislocation of pelvic bones. The picture of the film made after the patient arrives in the hospital does not truly portray the actual position of the bone fragments at the time of maximum displacement. It is impossible, therefore, to evaluate the damage to bone and soft structure from the roentgenogram alone. The history of the injury, and the kind, direction and severity of the force applied must all be taken into consideration. At the time of the accident was the bladder filled or empty? Was the bowel distended or collapsed? These are questions to be answered.

Complications associated with pelvic fractures may be listed as follows: shock; extraperitoneal hemorrhage; injury to large blood vessels in the pelvis; intra- and extra-peritoneal rupture of the bladder; rupture of the deep urethra; laceration of the perineum; injury to the rectum; and contusions and rupture of the kidneys. Among others there may be enumerated injury to the external perineal nerve with foot drop as described by Geo. G. Davis, who states that this is a complication in 2% of pelvic fractures; injury to the obturator nerve; acute gastric dilatation; acute or delayed ileus; edema of the lower extremities; extravasation of blood, urine and fecal material; local or generalized peritonitis; general septicemia; and pneumonia.

When one undertakes the management of these cases he is confronted with the treatment of the immediate emergency, then the reduction of fragments, and finally the treatment of complications.

In 1818 Sir Astley Cooper made the following statement: "I must caution the surgeon against making too minute an examination with the view of detecting the precise situation of the fracture, as he may easily do more injury by the examination than the discovery would compensate for." Although this was written 117 years ago, the statements that are made in it are as true now as they were then.

John Syng Dorsey in 1812 wrote as follows: "The fracture of the bones is in itself of less consequence than the mischief occasioned by the force which produced it. The contents of the pelvis must be contused by any force great enough to fracture bones which form it, and generally extravasations of blood take place into the cellular tissue which intervenes between the viscera of the pelvis." This statement also, made 123 years ago, is in entire accord with our present conception of pathogenesis.

ACTUAL treatment divides itself into (1) transportation of patients from the scene of accident to the hospital; (2) the immediate treatment of shock; (3) efforts at reduction of bony fragments, (4) subsequent immobilization of pelvic girdle and lower extremities; and (5) management of local and general complications.

The problem of the transportation of patients has been a subject of much discussion and consideration. The Fracture Committee of the American

*Presented at a meeting of the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East), Chicago, November 15, 1935.

1. LLOYD NOLAND, and H. EARLE CONWELL: Acute Fractures of the Pelvis, *J.A.M.A.*, January 18, 1930, Vol. 94, pp. 174-178.

College of Surgeons, and other organizations, have attempted in every possible way to emphasize the importance of care in the handling of fracture cases. It has been possible in some of the larger cities to have the private and municipal ambulances and patrol wagons equipped with suitable stretchers and splints. Special instruction is being given to ambulance drivers and to police and firemen along this same line. Workers in industry are also being taught the importance of careful handling of the injured person. Too often the simple fracture has been compounded by careless manipulation, and comminuted and compound fractures have been greatly disturbed during transportation, and thus the mortality from shock has been greatly augmented.

The scope of this paper does not permit time to discuss the management of shock, nor do I feel that this is necessary before this group of surgeons. It is a well known fact that every fracture of the pelvis carries with it a marked initial shock and that immediate and efficient treatment must be instituted at the earliest possible moment. I should like to warn against the indiscriminate use of intravenous fluids in large amounts, especially in older individuals. I believe that fluids are necessary in those cases where there has been a considerable loss of blood, but where this is not the case other remedies, together with complete rest, will suffice. Fluids by rectum should not be given at any time in fractured pelvis cases unless it has been positively demonstrated that there has been no injury to any part of the intestinal tract.

I believe that actual manipulation of the bones of the pelvis is undertaken much too frequently by the inexperienced surgeon. It is a well known fact that complete relaxation on a suitable Bradford frame firm bed, together with traction on the lower extremities, will most often permit the bones gradually to assume a normal anatomic position. Open operation I believe is very rarely if ever indicated for the reduction of fragments, except in those cases where there may be a spicule impinging upon the pelvic viscera or organs.

Subsequent immobilization of fragments should continue over a period of six to 10 weeks, depending upon local conditions. I think that a circular plaster cast involving the pelvic girdle and lower extremities is not often indicated. The danger from decubitus and the difficulty in handling a case so encased in plaster far overshadow the benefit obtained by this method. I believe that an efficient Bradford frame singly or combined with the use of the overhead pelvic suspension frame, together with traction on the lower extremities, should probably be the standard method of treatment. In the use of the pelvic suspension frame, care must be taken not to permit lateral pressure upon the pelvic bones such as one might get with the use of a swathe or the ordinary suspension canvas. It is only in those cases where there is a separation of the symphysis or at the sacro-iliac joints that lateral pressure is indicated. Central dislocation of the head of the femur through the acetabulum can usually be managed without much difficulty. The immobilization of these fractures should be carried out over a sufficiently long period of time to bring about complete strong fibrous or bony union.

In those cases where gross blood is found in the urine, an immediate attempt must be made to determine the source. This may be the kidney, bladder or urethra. Injudicious instrumentation or intravesicle examination must be avoided. The great danger of cystitis and secondary infection of the entire urinary tract is so great that the greatest care and asepsis should be used even in the very simple catheterizations. Intraperitoneal rupture of the bladder or bowel calls for immediate attention, and nice judgment must be used on the part of the surgeon as to the time and extent of the surgical exploration. Urethral injuries as a rule can be managed without great difficulty or harm to the patient. Extraperitoneal extravasation of blood alone should usually not demand operation. If this extravasation, however, is of urine or other septic material, then immediate drainage should be made. In the female it is often possible to produce drainage through the posterior cul-de-sac rather than through an interior laporotomy.

The prognosis, at least in the early days, should always be guarded. No one can tell until all complications have been ruled out just what is going to happen. In the severe fractures no one can determine just how soon these bones will heal sufficiently strong for weight bearing.

I have already mentioned the mortality as given in the Noland-Conwell series; 16.2% is probably a high mortality in cases seen in civil practice or in connection with railroad cases. I believe, however, that it is not high when one takes into consideration the severe injuries as occasioned by employment in mines or by the more severe automobile accidents. Of the 30 deaths reported by these authors, 19 died in the first 24 hours after admission, three within 48 hours, three within 72 hours, two within three days, one within four days, one in 32 days and one four months after the accident.

The morbidity as regards the anatomic "line-up" of fractures is, I think, very high in connection with these pelvic injuries. Noland states that only about 55% of his total series were regarded as good anatomical results. Fortunately, a poor anatomical line-up does not mean a poor functional result. In women Gilmore believed that any case of pelvic trauma which left any permanent disability after an honest effort on the part of the surgeon and the injured had been made was rare indeed. Blaine, in discussing Gilmore's paper,[2] said that he was struck with the terrific amount of deformity that can happen in the pelvis and still not incapacitate the individual. He further stated that in his opinion the degree of deformity as seen in the x-ray film should not be a criterion upon which to estimate the possible disability that will result.

I believe that we should use great care and caution in attempting to determine the total or partial disability in connection with fractures and injuries to the pelvis. I think the determination should be made 10% from the x-ray film and 90% from a careful physical examination. In severe fractures, it is my opinion that six to nine months should elapse before any disability determination.

IN CONCLUSION: (1) Do not forget that every case of pelvic fracture is an acute emergency.

2. Do not fail to treat every case of pelvic fracture as if there were present a rupture of a viscus.

3. Do not fail to watch for kidney, liver and other abdominal injuries.

4. We must not underestimate the seriousness of a severe pelvic fracture any more than one would minimize a severe skull injury.

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2. W. H. GILMORE: Fractures of the Pelvis; Read before the Radiological Society of North America, December 3, 1928.

Soft Tissues of the Hand in Infection

—A Microscopical Study of the Pathological Changes Produced by Deep Cellulitis Complicated by Osteomyelitis—

by

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THE purpose of this article is to give the results of a histopathological study of the soft tissues of the hand in deep cellulitis, complicated by osteomyelitis. Literature on the subject of infected hands is filled with material on symptomatology, treatment, diagnosis and other aspects; but very little has been recorded on the micropathology of the hand and the necessity — in view of anatomical peculiarities — of its special consideration as a study in itself. So much of function is bound up here in such small space that there is not a large amount of subcutaneous and accessory tissue, as elsewhere in the body.

This study was begun and continued on the histopathological picture of infected fingers, amputated after a severe deep cellulitis complicated by an osteomyelitis. Both anatomical and pathological classifications are considered from without inward, when possible: skin, subcutaneous tissue, muscle, nerve, lymphatics, blood vessels, tendon sheath and tendon.

Case Histories

CASE 1. Tenosynovitis of the right index finger complicated by osteomyelitis. Male, aged 35. Patient presented himself at the hospital with an infected hand and a diagnosis of tenosynovitis of the right index finger. Attempt was made to save the finger by conservative treatment, and many visits were made, but the orthopedic department finally advised amputation at the metacarpo-phalangeal joint because of complicating osteomyelitis, and the finger was then amputated.

PATHOLOGY: The papillary and reticular layers are thickened. The subcutaneous tissue is seen to be edematous, including especially the deeper reticular portion of the cutis underneath the glands. The loose tissue is edematous and contains numerous pus cells, also swollen histiocytes and large mononuclear round cells. The muscle sheaths are destroyed in many places; the fibers are shrunken, the striations are absent and the nuclei are pycnotic. Scattered between the bundles are dense accumulations of lymphocytes, plasma cells and histiocytes. There is a marked round cell infiltration around the lymph vessels—a perilymphangitis. Plasma cells are also seen in great numbers around the lymph vessels. The blood vessel walls are thickened and infiltrated with round cells, with a definite thickening of the media. There are seen also focal perivascular accumulations of plasma cells, round cells and histiocytes.

CASE 2. Restoration operation attempting to re-suture tendon was done, and the finger amputated on failure to find tendon ends. Patient received a deep laceration on the palmar surface of the left index finger over the metacarpo-phalangeal articulation, extending down to the bone and severing the tendon. The tendon was supposedly sutured by the family physician, but the finger was stiff when it healed and could not be used. This patient entered the hospital seven months later and an attempt was made to find the ends of the tendon and re-suture. When this was impossible the finger was amputated, in the interest of a functional hand. This specimen is used to find what condition prevails on division and failure of junction of a tendon. It is not exactly typical of the other cases.

PATHOLOGY: An extensive hyperkeratosis is a prominent feature here. The zona lucidum is very distinct and there is some thickening of the papillary layer. There seems to be some slight edema of the underlying subcutaneous tissue. The muscle tissue seems to be fairly intact. The nuclei are plainly visible.

Old blood pigments are seen. Large cells are collected about the blood vessels. It appears to be an old organic process.

CASE 3. Tenosynovitis of the finger complicated by osteomyelitis. History was unobtainable in this case but the pathology shows it to be parallel to the other cases recorded.

PATHOLOGY: In this specimen the cutis and subcutis are densely infiltrated, chiefly with plasma cells. There is some proliferation of the fibrous elements. The cutis shows considerable edema. Some parakeratosis of the epidermis is seen, with intercellular edema of the cutis. There is diffuse round cell infiltration with plasma cells in the cutis and subcutis. The inflammation extends up to the papillary layer, all tissues showing edema and infiltration with plasma cells, round cells and some histiocytes. The papillary layer also contains some of a similar exudate, but to a lesser degree. It tends to be perivascular. The muscles show marked degeneration: striations are absent and the nuclei are pycnotic and sometimes absent. Perivascular infiltration of round and plasma cells is seen. The lymphatics are dilated but the lumen in each case is free from cells.

CASE 4. Tenosynovitis complicated by osteomyelitis of the thumb. Female, aged 24, entered the hospital with osteomyelitis of the distal phalanx of the thumb. The patient ran a sewing needle into the thumb and it later became infected. Treatment was instituted, but it did not react well and osteomyelitis developed. Later there was an amputation of the nail and part of the soft tissues of the end of the thumb with a small portion of the bone. The x-ray of the bone showed osteomyelitic rarefaction.

PATHOLOGY: Hyperkeratosis of the epidermis is seen. The subcutaneous tissue shows an increase in the number of blood vessels and blood extravasation over the entire area. The blood vessel walls seem to be thickened and the endothelium swollen. The lymphatics are open and apparently larger than normal. The blood vessel walls are infiltrated with cells, especially the intima and media.

CASE 5. Infection of soft tissues of the ring fin-

ger with gangrene. Male, aged 36, entered the hospital after a crushing injury to the left hand, following an auto collision on November 20. The left hand was laid wide open at the palm with tendons, arteries and veins severed. The index and second fingers were shorn of skin and muscle, leaving the bone bare. The ring and little fingers were denuded from the base to the middle flexion crease and the power of flexion was lost.

Record: On November 23 the condition was good. On November 24 drains were taken out; on November 26 patient was up in a wheel chair; on November 27 the wound was gaping and infection of the ring finger was present. The sutures were removed, strips applied, and Dakin irrigation instituted. There was pain in the axilla and shoulder. The tendon was pointing through the wound and strips were used to hold the tissues in place. On December 1 patient felt well; also doing well on December 2; on December 3 wound still draining, but on December 5 the finger had become gangrenous and decision was made to amputate. On December 8 the ring finger was amputated and patient was showing slow improvement by December 10.

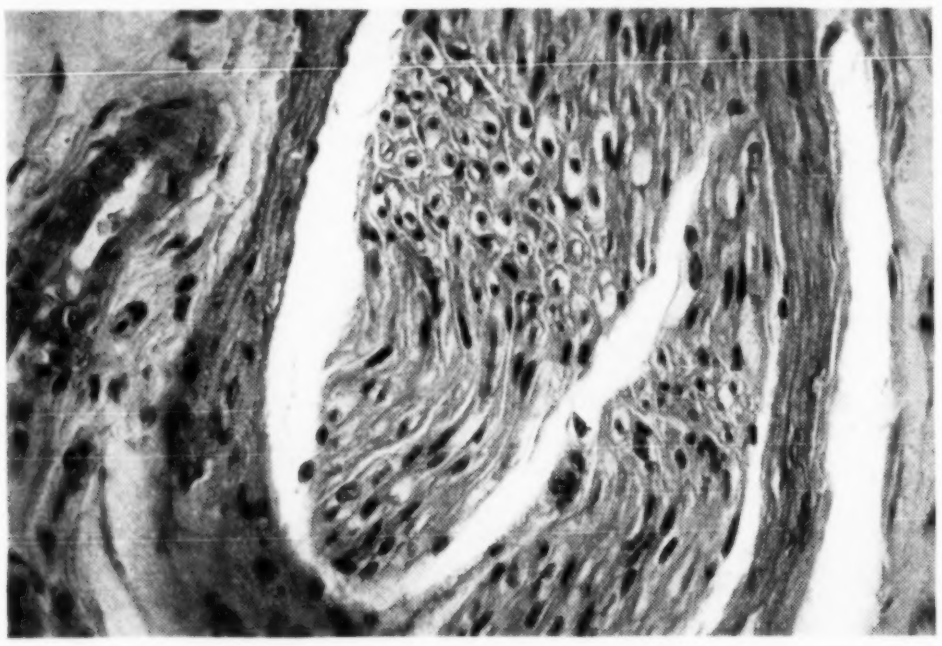

Fig. 1. Nervous tissue revealing axones, axis cylinders and myelin well preserved after 5 weeks' contact with pus and pressure of inflammatory products. Endoneurium and perineural tissues are densely infiltrated with plasma and round cells.

PATHOLOGY: The skin and subcutaneous tissue are seen here. The skin seems to be somewhat thickened. The subcutaneous tissue seems somewhat edematous and infiltrated by round cells and some leucocytes. The infiltration seems to be somewhat perivascular in character. No specimen was obtainable here of nerves, tendons or tendon sheaths.

CASE 6. Infection of soft tissues of the hand complicated by osteomyelitis. On January 3, a male adult patient caught his left hand in the pressing rolls of a machine. There was contusion and abrasion to the dorsum of the left hand, with extensive laceration at the base of the middle and ring fingers on the palmar aspect extending to the profunda digitorum tendons. Deformity and crepitation were noted in the proximal phalanx of the ring finger. Lacerations were sutured and splint applied to immobilize the fracture.

Findings: On January 4: temperature 98°, pulse 80, respiration 18; January 5: temperature 100°, pulse 80, respiration 20; January 7: temperature 100°, pulse 76, respiration 16; splint was removed. On January 10: temperature 98°, pulse 70, respiration 20; hot packs were continued. On January 20: temperature 97°, pulse 80, respiration 20; amputation of the ring finger was done. On February 10 the sutures were removed, and the patient was discharged on February 13.

PATHOLOGY: The subcutaneous tissue is edematous and infiltrated by round cells and granulocytes. Round cell infiltration of the muscle is seen here, predominantly polymorphonuclear. There is some destruction of the muscle fibers. Necrotic tissue is seen among the muscle bundles, which are destroyed by dense accumulations of pus cells. There is also extravasation of blood among the muscles and separate bundles. The tendon is broken into strands and infiltrated with leucocytes. The tendon strands are irregular and in places the continuity of the tendon is practically obliterated.

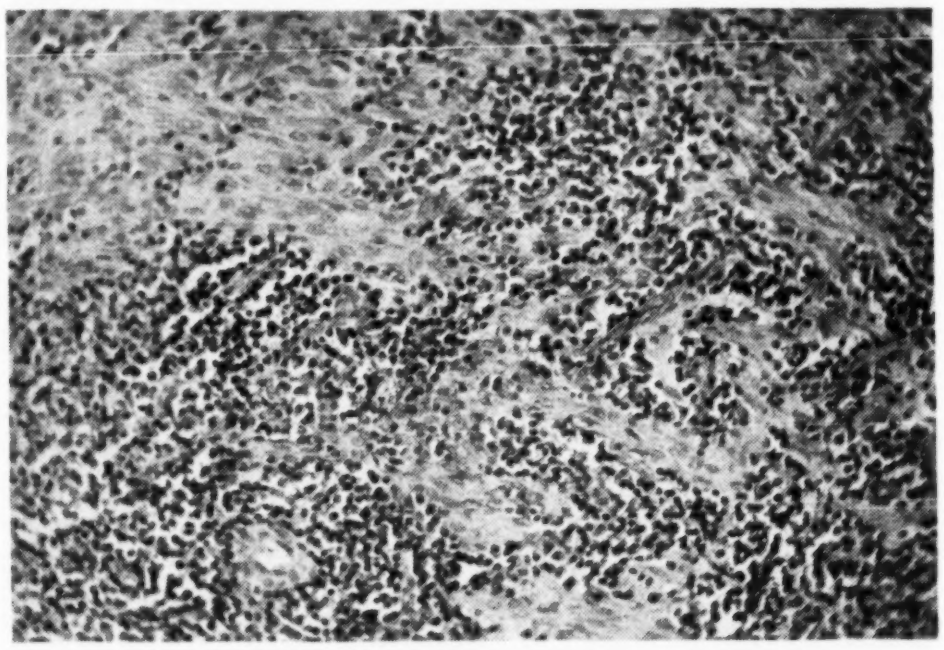

Fig. 2. Muscle tissue revealing rupture of the sheath with shrinking of fibers, loss of striations, loss of nuclei and infiltration of muscle bundles with interruption of continuity.

CASE 7. Infection of the soft tissue complicated by osteomyelitis. White female, aged 42, came in with pain and swelling of the left little finger, which had existed for six weeks. She stated that she had cut her finger with a knife, after which the finger seemed to get well in one week. Then it began to swell and become painful. She got medicine at a drugstore and bathed the hand in hot antiseptic solution. The finger kept getting worse for about five weeks and she then entered the hospital. On examination the finger showed marked redness and swelling and a small draining purulent opening in the region of the middle joint. There was abnormal mobility and crepitus elicited in the middle joint of the little finger. Amputation was done on December 22; and the finger was redressed. On December 24 condition was good but with small amount of pain around the incision. On December 26 the patient was improving, and on December 30 there was only a small area of non-healing. On January 3 an x-ray was taken. On January 4 no pus was found and the patient was sent home.

Diagnosis at operation: Osteomyelitis involving the joint between the proximal and middle phalanges of the left little finger.

PATHOLOGY: The nervous tissue is especially demonstrable here. The nerve fibers are well preserved. The axones as well as the myelin are preserved, but the endoneurium and the perineural tissues are densely infiltrated with plasma cells. These are so numerous that in some places they appear as if in pure cultures. The Schwann cells are well marked, their nuclei are rich in chroma-

tin, and in some places there are accumulations of large nuclei scattered in the endoneurium. These are nuclei of proliferated fibroblasts. The blood vessels are not prominent and no perivascular infiltration as such can be determined. Polymorphonuclear leucocytes and even lymphocytes are totally absent. The condition is what has been described as intersititial neuritis. The perivascular lymph spaces are clear and plainly made out.

CASE 8. Infection of soft tissues complicated by osteomyelitis. History was unobtainable in this case, but the pathology shows it to be a case of infection of soft tissues, complicated by an osteomyelitis.

PATHOLOGY: Blood vessels are especially shown here. There is some edema and beginning degeneration of the endothelial tissue and of that underlying. There is round cell infiltration in the perivascular tissue, with a few macrophages. Perivascular infiltration is seen around the small vessels. There is subendothelial proliferation. The endothelium seems to be slightly thickened.

CASE 9. Deep cellulitis complicated by osteomyelitis. Patient was at work wrecking a machine and caught his left ring and little fingers in the rolls. The little finger was amputated and the patient presented himself with the ring finger considerably swollen and discharging pus. The stump of the little finger healed by first intention, but osteomyelitis continued in the ring finger and it was necessary to amputate.

PATHOLOGY: The muscle is infiltrated and broken into strands coated on the sides by a lymphocytic infiltrate. In some places where the infiltration is greater in extent, strands of broken muscle are seen here and there. The original muscle in places is almost obliterated. The original larger blood vessels seem to have been obliterated but the new growth seems to have carried in numerous new capillaries. Fat occurs in areas where the infiltration is thinning out. The infiltration seems to follow fascial planes. Muscle nuclei are dark and pycnotic and the muscle appears to be frayed. The nerve shows round cell infiltration, connective tissue infiltration, and areas which appear to be pseudo-neuromatous growths.

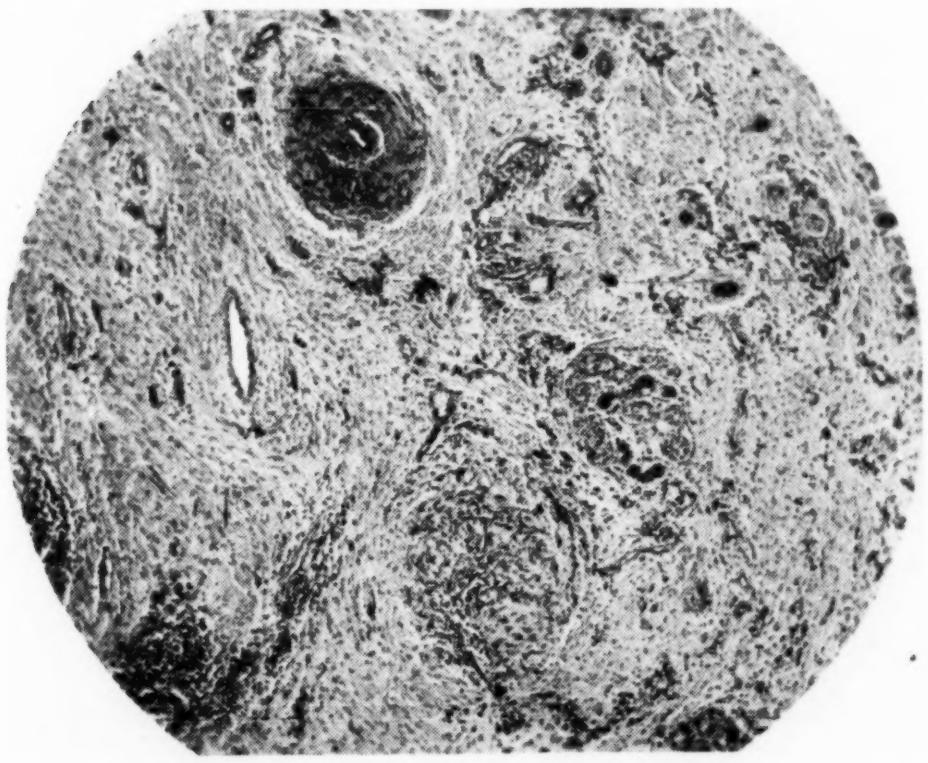

Fig. 3. Blood vessels revealing a thickening and round cell infiltration of the walls throughout, with varying degrees of degeneration of endothelial and sub-endothelial tissues. Lymphatics reveal infiltration of the wall and dilatation of the lumen.

Technique

MOST of the specimens were fixed in 10% formalin as soon as removed. Nos. 1, 2, 3, 4, 6, 7, 8 and 9 were done in this manner, while No. 5 was placed immediately in Zenker's solution. Blocks were cut from this fixed material, to show as well as possible the soft tissues of the hand: skin, subcutaneous tissue, blood vessels and nerves, in the region of greatest destruction. Attempt was made to include all parts of the soft tissues. The tissues were then washed in water for 24 hours and dehydrated by successive strength alcohols, then treated with xylol and paraffin and mounted on blocks. These were then cut into sections and placed on slides. In some, sections of the ribbon were taken at random from various parts of the block, while in others sequential series of 10 to 15 slides were made by taking parts of the entire strip at fairly equidistant intervals. The slides were then treated to remove the paraffin by xylol, passed through the series of alcohols and stained with four different stains and mounted. Haematoxylin and eosin were first used. With this the basic haematoxylin stains nuclear structures blue, while the acid eosin stains cytoplasm red. Mallory's Phosphotungstic Acid Haematoxylin was used secondly, which stains neuroglia, myoglia and fibroglia fibrils and fibrin blue and collagen fibrils, reddish-brown. Mallory's Connective Tissue Stain was used in the third place, in which fibrils of connective and reticular tissue, amyloid and mucus stain blue; nuclei, cytoplasm, muscle, axis cylinders and neuroglia fibers stain red; and red corpuscles and myelin stain yellow. Von Gieson was used for the fourth stain. It stains the myelin sheath and axis cylinders red. These slides were then studied under oil immersion lens for pathological pictures present.

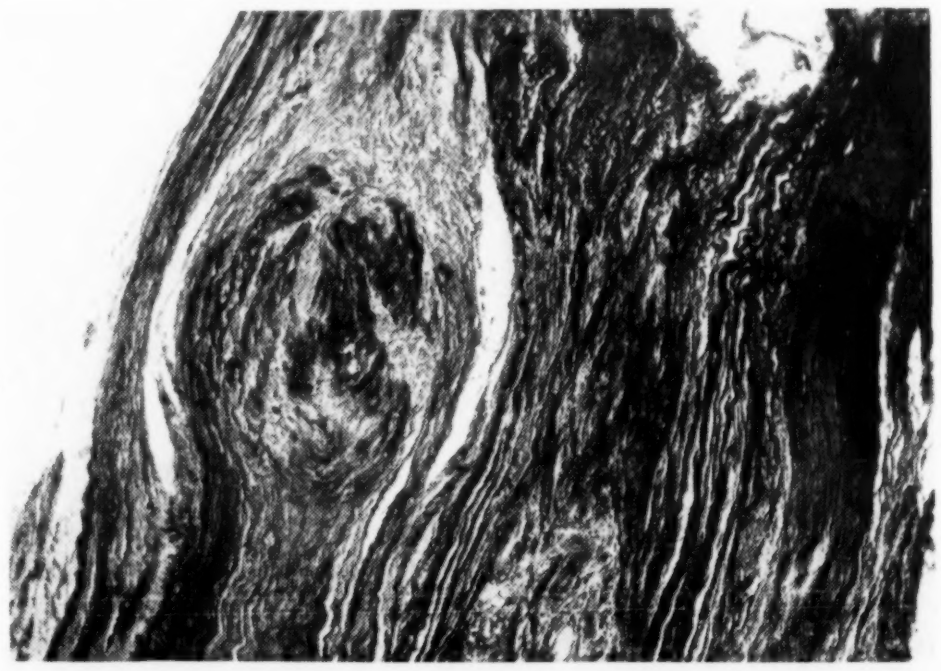

Fig. 4. Longitudinal section of nerve revealing a pseudoneuromatous formation similar to that described by Tinel with fibrosis following traumatic injury and hemorrhagic extravasation. This was not constant finding in this series.

Discussion

PATHOLOGY in the hand is similar to that found elsewhere except in result which is so profoundly influenced by anatomical structure.

The skin under these conditions almost always shows a hyperkeratosis and the papillary and reticular layers are thickened. The cutis is often densely infiltrated with inflammatory cells, which are plasma cells if it is a fairly long continued pro-

cess. The cutis may also show considerable edema. The inflammation sometimes extends up into the papillary layer, with all tissues showing edema and infiltration with plasma cells, round cells and histiocytes. The deep reticular layer of the cutis may be very edematous. This hyperkeratosis and thickening of the skin further accentuates the retention of inflammatory products.

The loose subcutaneous tissue is generally edematous and infiltrated with numerous pus cells if early in the course, or with swollen histiocytes and large mononuclear cells if late. It sometimes shows an increase in the number of blood vessels present and extravasation of blood over the entire area. In places it may be replaced by fibrous tissue which, while often obliterating the larger vessels, carries in with it a numerous new growth of capillaries. This tissue, with its edema and fibrosis, leads to compression of blood supply and later to fibrotic interruption of nerves and contracture.

The muscle sheaths are destroyed in many places and the fibers are shrunken. The striations are absent and the nuclei pycnotic or absent. Scattered between the bundles and sometimes even between the fibers themselves are dense accumulations of lymphocytes, plasma cells and histiocytes. In more severe and advanced cases there is complete destruction of part of the muscle bundles, with areas of debris and necrotic tissue among certain muscle bundles, which are destroyed by dense accumulations of pus cells. Blood may often be extravasated among the muscle bundles or between the individual fibers. The muscular tissue is often broken into strands and looks as if lined on all sides by lymphocytic infiltration.

In certain places the infiltration breaks through and the continuity of the muscle bundle is completely obliterated. This especially happens to muscles in this region; first, because there is such a shallow layer of subcutaneous tissue; and, second, because the fascial capsules of the palm are so firm that, unless drained early by surgery, inflammatory products are enclosed and develop a high pressure, which tends to make the process burrow deeper into the muscle, seeking an outlet rather than discharging onto the surface. In the hand with small muscles and limited field of motion, a high specific disability results from fibrous replacement and contracture during healing.

The blood vessel walls are often thickened and infiltrated with round cells, with definite thickening of the media; or sometimes the pathological changes are most marked in the endothelium and intima. The outer layers of the vessels are almost always infiltrated and show perivascular accumulations of plasma cells, round cells and histiocytes. There is sometimes edema and beginning or complete degeneration of the endothelial or the subendothelial tissue. The original larger vessels especially of the subcutaneous tissue may be obliterated by fibrous tissue and the new tissue filled with numerous ingrowing capillaries. If more active, the process may show complete erosion and loss of continuity of the small vessels, with extensive blood extravasation into the surrounding tissues. This condition is especially liable from the anatomical condition with its confinement of inflammatory products. The distal phalanx is especially liable to occlusion of blood supply and necrosis.

The lymphatics often show perivascular infiltration. They may be closed by compression or the lumen may be open and is sometimes clear, sometimes filled with debris. In many cases the lymphatics seem to be dilated to a larger size than normal.

The nerve fibers are well preserved. That is a most striking thing, in view of the fact that they have been subject to the ravages of infection occurring with an osteomyelitis for as much as five weeks, liable to all the dangers in the same manner as the other tissues. The axones and axis cylinders stain as clear and unharmed as in a normal section. Both axones and myelin are preserved, but the endoneurium and perineural tissues are densely infiltrated with plasma or round cells.

The Schwann cells are well marked, their nuclei are rich in chromatic material and in some places there are accumulations of large nuclei scattered in the endoneurium. These are nuclei of proliferated fibroblasts. It gives the same pathological picture as that described as interstitial neuritis. The nerve is infiltrated with fibrous tissue and cells, and in one place a pseudo-neuromatous growth appears similar to those which appear after fibrosis and hemorrhagic infiltration following traumatic injury. In some parts there is connective tissue infiltration into the nerve bundle, but the nerve elements maintain their integrity. Here is shown the wonderful vitality which nervous tissue has to withstand ravages which destroy other tissues.

The tendon sheath is often invaded and broken down and the tendon itself broken and infiltrated with leucocytes. The tendon strands are irregular and in places the continuity may be entirely obliterated. This rupture of the sheath and invasion of the tendon itself explains the loss of function and contracture of tendons which so often follow infections of the hand. The bone in these fingers shows rarefaction of density in every case under x-ray.

The foregoing discussion shows how pathology in the hand differs with the anatomy, and should tend to emphasize the care necessary in the treatment of hands with cellulitis and tenosynovitis.

Summary

IN TENOSYNOVITIS complicated by osteomyelitis, pathology shows:

1. The skin and subcutaneous tissues show edema, round cell infiltration, fibrous replacement and varying degrees of necrosis.

2. The muscular tissue shows rupture of the sheath, shrinking of the fibers, loss of striations, loss of nuclei and infiltration of the muscle bundles, with varying degree of necrosis and interruption.

3. Blood vessel walls show thickening and round cell infiltration sometimes throughout. Varying degrees of degeneration are seen, especially in the endothelial and subendothelial tissue.

4. Lymphatics show a perilymphocytic infiltratration and sometimes an abnormal dilatation.

5. Nerve fibers are remarkable in the fact that they remain well preserved even after long continued exposure to compression with inflammatory products. The axones and axis cylinders stain clear and normal after as much as five weeks of such exposure.

6. The tendon sheath and tendon break down before the onslaught and are seen infiltrated with cells and with continuity interfered with in varying degrees or completely obliterated.

7. The bone in each case shows osteomyelitic rarefaction.

Review of the Literature:

LOCAL destruction or injury appears to be due to poisoning of the tissues by toxins and also cutting off of blood supply from the tissues by pressure of inflammatory products in enclosed spaces. The ends of the fingers are covered by a firm, inelastic, fibrous capsule, with columns of fibrous tissue forming a framework enclosing the fat. Sweat glands dip down from the skin into the capsule and form portals of entry of infection. Nerves to the corpuscles of Pacini pass through this capsule and also vessels to the diaphysis. Compression results on delicate nerves supplying touch sensation of the fingers, so neglected infection often leaves permanently damaged tactile sensation.[1]

The terminal phalanx is a closed space and prevents spread of inflammatory products, but the blood supply is easily cut off, especially for the diaphysis. The epiphysis escapes for a time, as its blood supply arises higher in the finger and need not traverse the compressed pulp of the terminal phalanx.[2]

Closed spaces lead to pressure; the septa in the ends of the fingers divide it into fatty spaces and extend down to the periosteum.[3]

The fibers at the tips of the fingers are closely connected with the periosteum, and lymphatics carry infection direct to the bone.[4]

Increase in tension in the distal phalanx leads to occlusion of vessels, then involvement of the diaphysis of the terminal phalanx through the lymphatics. The vessels of the epiphysis escape occlusion, which is very fortunate, for both flexor and extensor tendons are inserted into the base of the last phalanx, mainly in the epiphysis, so function is not seriously impaired. This is important as the flexor tendon sheath is most closely related to the pulp, so that neglected felons occasionally lead to tenosynovitis. The firmness of the palmar fascia leads to special compression of the palm, and the looseness of the tissues on the dorsum of the hand leads to appearance of swelling there early, even when the pathology is on the palm. With so many things of importance so close together in the palm and fingers, infection of one leads rapidly to involvement of the others. The flexor tendons are very closely placed to the bones on their palmar surface, especially over the middle phalanges, which often leads to an osteomyelitis from a tenosynovitis.[5]

Lymphatic channels take the shortest course to the back of the hand. The connective tissue of the terminal phalanx constitutes a more or less closed chamber divided into chambers by fibrous septa. Infection introduced directly through the columns of fat leads to compression of digital blood vessels and shutting off of supply of the bone, within a few days.[6]

Inflammation and pressure phenomena may subside in the distal phalanx, but it is transformed into a bluish, distended, swollen mass.[7]

Infection of the hand if enclosed leads to necrosis of the subcutaneous tissue.[8]

Neglected injuries of the hand without drainage lead to rapid sloughing of the tissues.[9]

There is an outpouring of lymph, and a local aggregation of phagocytes in limited areas, causing a high degree of tension and endangering the vitality of the part. With this stasis of circulation there is a concentration of toxins and proteolytic ferments liberated from the dead and dying phagocytes, which cause death, and liquefaction of tissue and prolonged suppuration are inevitably followed by fibrosis, with fixation of tendons and muscles, stiffening of joints and compression of blood vessels and nerves. [10]

Constriction at the metacarpo-phalangeal region of the tendon sheath often prevents passage of the infection into the digital portion, and a probe must not be passed here down into the sheath to the finger. Local destruction or injury appears to be due to poisoning of the tissues by toxins and also cutting off the blood supply of the tissues by pressure of inflammatory products in enclosed spaces.[11]

In paronychia the infection begins at the side of the nail, the tissues about the nail become red and swollen a little, pus is discharged from a tiny opening at the side of the nail, and the condition progresses until the tissues become bluish and swollen and granulation tissue develops about the site of the infection. Because of the proximity of the bone to the nail bed, secondary osteomyelitis may develop very easily. Subcutaneous abscesses often develop under the transverse fibers of the palmar fascia in the soft tissues between the fingers, so that the soft, elastic tissue on the dorsum becomes swollen, tense and indurated, and the deep pocket of pus lies deeply on the dorsal aspect of the superficial transverse ligament. Infections within the tendon sheath spread with remarkable rapidity, and destruction of tendon sheath and tendon ensues rapidly unless promptly drained. Infections of the dorsum without drainage lead to necrosis of the tendons and secondary osteomyelitis with persistent swelling and long continued discharge, which can be relieved only by adequate drainage and removal of necrotic tissue.[12]

Best gives a complete picture of the tendon sheaths or spaces of the palm by injections of all the spaces with opaque material, with later dissection and x-ray.[13]

Between the tendons of the palm and metacarpal bones with the interossei muscles, a more or less closed space exists open towards the finger, and into this potential cavity infection often enters to form palmar abscesses. Tendon sheath infection arises from an open wound or secondary to an infective focus in the neighborhood, though it is rare. Streptococci are carried by lymphatics to the sheath.[14]

Neglected pressure within the hand leaves permanently damaged tactile sensation.[15]

When a sheath contains pus for considerable time, the synovial surfaces become severely damaged.[16]

Gradual sloughing of the lacerated edges of wounds with inflammatory exudates changes to scar tissue by fibrous transformations of granulation tissue. Fibrous contractions of the granulation tissue lead to scar formation. Fibroid alteration of muscle bellies also may take place.[17]

Contraction of the palmar fascia may take place and also the palmar metacarpo-phalangeal ligament between the fingers, thus drawing the phalanges together at the metacarpo-phalangeal articulation. Muscular fibrosis is often seen; adhesions of tendons to the skin and other tissues; stiffness of joints and trophic changes. On the concave side of the injury the tissues become shorter and thicker, while on the convex side the tissues lengthen and attenuate, leading to deformity.[18]

Hand infections result in stiffness and ankylosis of joints; adhesions of tendons and loss of tendon

substance; contracture of muscles, tendons and fascia and lesions of nerves. Severe infections with prolonged swelling for weeks or months show limitation or absence of active and passive motions. Fingers are fixed in extension or slight flexion. The skin is smooth, glossy, pale, or bluish and cool. There is thickening and induration about the finger joints.[19]

Long ischemia provokes a generalized tissue reaction, which results in a degree of firm induration of the parts which does not endure beyond an hour, and slight reaction is seen in two hours. Trauma, infection and operation are usually followed by dense induration; but will undergo a softening process in time, though it may take as long as a year. In closed spaces as under the annular ligament, in tendon sheaths and in fascial spaces, swelling is limited and necrosis follows from ischemia.[20]

Deep cellulitis and tenosynovitis may follow penetrating injuries or extension, followed by sloughing of flexor tendons; adhesions of tendon sheaths; osteomyelitis of middle and proximal phalanges; suppurative arthritis of proximal interphalangeal joints; atrophy of tissue of the whole digit; contracture of scars; necrosis of the wall of the radial artery; or sloughing of the fascial layer.[21]

One of the most lamentable consequences of the severe or untreated types of acute infections in the hand is seen in the contractures producing deformity and disability. In the severer types most extensive pathological changes are found. The anatomical and clinical evidence already adduced shows the tendency for the infection to spread along the blood vessels and nerves. This leads to compression of the blood vessels and lymphatics, producing a persisting distal edema, while the contraction of the scar tissue about the nerves leads to trophic changes.[22]

Because of the direction of the lymphatic drainage, the dorsum of the hand is swollen and edematous, but pus will not be found on the dorsum except in those neglected cases in which the infection has extended distalward along the lumbrical canals and passed to the dorsum in the subcutaneous tissue about the web of the finger. Only in grave, neglected infections in which osteomyelitis has taken place does pus find its way through the barrier of deep fascia interosseous muscles and metacarpal bones from the palm to the dorsum of the hand.[23]

One occasionally sees cases in which the suture of tendons on the back of the hand has been followed by a slight localized infection without serious impairment of the operative result, but we recall but one case in which a low grade infection developed after suture of the flexor tendons without impairment of the final result.

In the majority of such cases which have come under our observation there has been extensive spreading of the infection with eventual necrosis and sloughing of superficial tissues and ankylosis of joints as well—conditions which make it necessary to postpone any attempt at operative repair for long periods of time and often make operative restoration practically impossible of accomplishment.[24]

There are three main types of bone infections of the hand: those cases where the distal phalanx is the seat of osseous destruction, where the finger proper is involved, and where the metacarpal and carpal bones are involved. Osseous destruction of the distal phalanx is very common and frequently follows infection of the soft tissues, as mentioned previously. The greater part of the terminal phalanx is a closed space, so that when inflammation occurs exudation results, the tension is raised and pressure on the veins leads to further exudation.

Finally vascular thrombosis results, followed by necrosis of the diaphysis of the terminal phalanx, the base commonly escaping owing to the origin of its blood supply from without the closed space.

The proximal interphalangeal joint may become involved early, either primarily or secondarily, whereas the metacarpo-phalangeal joint is seldom involved. The proximal phalanx escapes while the epiphysis and part of the diaphysis of the middle phalanx is destroyed. The bone becomes involved shortly after the joint is infected and necrosis follows.[25]

Where we see long continued suppuration in the hand there is in all probability necrosing tendon or devitalized bone requiring adequate surgical procedure.[26]

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Who's Who in I. M. & S.

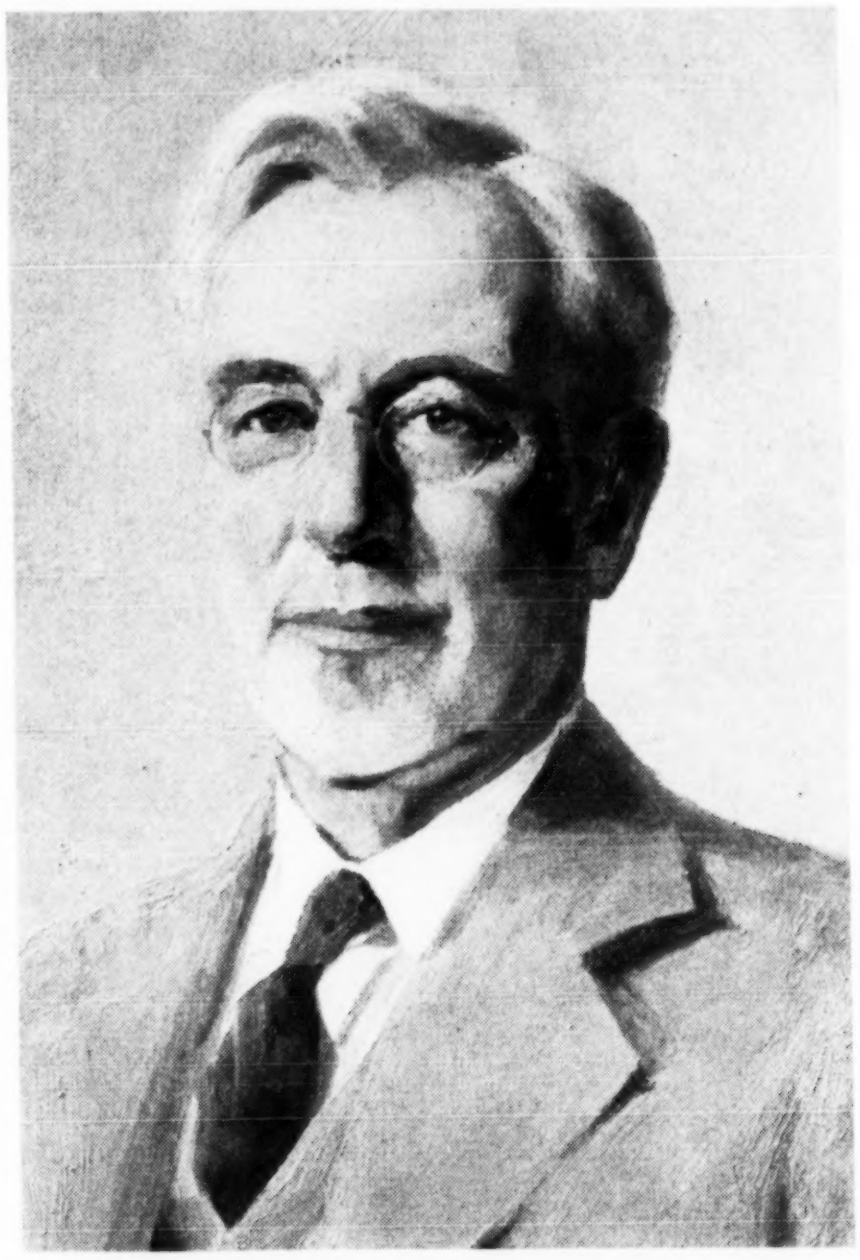
—An Interesting Career, Now About to Pause and Receive the Accolade: "Well Done!"—

ABOUT 1910, rumors became rife in London that Mr. Kipling, having attained the poise of mind to be content with the achievements that were his, was getting ready to rest on his laurels. An editor thought to reduce the gossip to certainty, and sent a reporter for an interview. Believing his chances better in the evening than during the day, the reporter presented himself at Mr. Kipling's residence at an after-dinner hour. But he couldn't get past the door; Mr. Kipling was indisposed and could not be seen. Realizing after much argument the futility of trying to gain his point, he said to the butler:

"Well, since *you* seem to be able to get to Mr. Kipling, ask him if he is going to retire."

In a little while came back the answer, delivered with the characteristically impossible gravity:

"Mr. Kipling *has* retired."



SAMUEL CRAIG PLUMMER

This is illustrative of the fact that there are several kinds of retirement.

The one kind that appeals to everybody, however, is that which crowns a career, closes a record of service and a long roll of things done, and comes in life's late afternoon while the sun still beams upon the perspective and the air has only the faintest suggestion of the cool, long reaches of the night that soon "shall shape and shadow overflow." Every man has the hope that his own retirement will be that kind. Inarticulate in the main, and modified by the place and circumstances of the one who holds it, this hope is, nevertheless, the genesis of all the pension systems that were, and the will-o'-the-wisp of most of the "social security" that can never be. The man who sees it at hand for himself, therefore, is fortunate. He will continue to be fortunate in accordance with what he does with it.

There are rumors now that Dr. Samuel C. Plummer, Chief Surgeon of the Chicago, Rock Island & Pacific Railway since August 8, 1902, is about to retire. In a manner of speaking, the rumors are true: on April 30, 1936, Dr. Plummer will give over the duties of his office to a successor, and thereafter will not be Chief Surgeon. He will, however, continue as Consulting Surgeon. In the sense, therefore, that a part of his work is done, a phase of his career drawn to its close, he may be retiring from its particular activities. But he is not withdrawing from his profession, nor even suspending the habits of intellectual application therein which he developed and which, in turn, have developed him. For how can a mind retire — particularly a mind as keen and alert as his? How can an intellect be pensioned? Any "retirement" of such a personality is only functional; the term when so applied is but the shibboleth of an earned and merited transition.

SAMUEL CRAIG PLUMMER, M.D., F.A.C.S., was born at Rock Island, Ill., April 27, 1865, the son of Samuel C. and Julia (Hayes) Plummer. His heritage is thoroughly American: his father's line goes back to the Francis Plumer who came over from England and settled at Newburyport, Mass., in 1633, and his mother's family, likewise, find an ancient and honored origin in the early American panorama. Schooling began at six; high school, at Rock Island, was finished at 15, and Augustana College, at 18, with A.B., A.M., and Ph.D. earned and received. Then to medical school, and he chose Chicago Medical College, which was in fact Northwestern University Medical School, having united with Northwestern in 1869, retaining its separate name, however, until 1891. Graduating M.D. in 1886, he interned at Cook County Hospital, Chicago, beginning in April, 1886, and continuing until October of the following year. A while later he established himself in general practice at Luverne, Minn,. a little town of 2,000, in the southwestern part of the state. There he was elected Coroner of Rock County, adding the duties of that office to the demands of a country doctor's practice.

But he was cut out for more than that; and so, in answer to the urge that subconsciously guides careers, he came back to Chicago in 1891, set up in general practice, and identified himself again with Northwestern Medical School—in a teaching relation that was to continue for 17 years, and was to find him successively Lecturer on Anatomy, Professor of Anatomy, Demonstrator of Operative Surgery, Professor of Operative Surgery, and Clinical Professor of Surgery. (The Harper portrait from which the half-tone on this page was

made, now hangs in the Church Library, at Northwestern University Medical School).

Those were important years. They were the years in which there grew in his mind, and developed in his methods, the importance of antiseptic surgery. The beginning of his strong interest in this subject was a lecture at Medical School, which impressed very strongly upon him the fact that the technique of the time was poor; that all surgical cases became infected; that this was the expected routine, so much so that surgeons were alarmed by the absence of infection. Naturally enough, therefore, he listened eagerly when Christian Fenger began his remarkable, and historical, demonstrations of antisepsis at Northwestern and Cook County Hospital. So eager and so responsive was he that in 1893 he became Dr. Fenger's assistant, and for five years he watched, and studied, and absorbed, and applied what he learned—with such effect that when, during the early 1900's, there was ushered in the new era in surgery which came with antiseptic technique, he was, in knowledge and in application of knowledge, himself one of the ushers.

And thus he was ready when, in January, 1899, he had the opportunity to broaden into railroad surgery, becoming Local Surgeon for the Chicago, Rock Island & Pacific, at Chicago. And maybe it was the same readiness—in perception of trends and preparation for them—that helped swing the balance in his favor when, only three and a half years later, he was made Chief Surgeon. At any rate he was so appointed on August 8, 1902, at the age of 37; in 1904 he limited his practice to surgery; and continuously, and successfully, he has been the Rock Island's Chief Surgeon ever since. Continuously—except for the war years. And then, too, he was ready. For some reason—which probably at the time had no apparent place in any pattern of his life—he had become First Lieutenant in the U. S. Army Medical Corps in 1911, and thus, when the Base Hospital units began to be assembled in 1917, he had a sufficient military background to secure him the leadership of one of them. Ranking as Major, he was attached to Base Hospital No. 14, which was equipped by St. Luke's Hospital, Chicago, and sent to Camp Custer, Mich., in November, 1917, and then to France in July, 1918. There No. 14 became one of the 1000-bed operating units at Mars-sur-Allier Hospital Center. And there he was No. 14's Chief of Surgical Service, and Consulting Surgeon for the Hospital Center as a whole, until January 15, 1919.

When he first became a railroad surgeon, there existed an organization called the International Association of Railway Surgeons. Looking it up, with a view to becoming a member, he found that as a social body, able to have a good time at conventions, this organization was a big success, but that its meetings, although held as per program, were never certain to be attended by more than the day's chairman and the scheduled speaker. Sight-seeing may not have been the announced intention of the gatherings, but it was the actual business of most of those who came. This did not appeal to the serious-minded; and so a small group who cherished the notion that such conventions should be useful as well as pleasant, organized the Academy of Railway Surgeons, and 1903 found Dr. Plummer its president. This move had a salutary effect: the two bodies held a joint meeting in 1903; voted to unite; decided to get down to serious business; and emerged as the American Association of Railway Surgeons. Dr. Plummer, at this writing is the Association's Acting Treasurer, and Chairman of the Executive Board.

He is a Fellow of the American College of Surgeons; and a Fellow of the American Medical Association. In the latter he was at one time a member of the House of Delegates. In the Illinois State Medical Society he was for a period secretary of the Section on Surgery. For two years he was treasurer, and for another two years secretary, of the Chicago Medical Society. The Association of Railway Chief Surgeons elected him to its presidency; the Chicago Surgical Society did the same; and the Western Surgical Association followed suit. He is also past president of the American Association of Railway Surgeons. The Institute of Medicine of Chicago, the American Surgical Association, the Society of Medical History of Chicago, and the Association of Military Surgeons of the United States are the other medical organizations to which he belongs. For many years prior to 1933, when he withdrew, he was a member of the American Public Health Association. He was Attending Surgeon, at Wesley Memorial Hospital, Chicago, from 1900 to 1908; since then he has been Attending Surgeon at St. Lukes.

In March, 1903, he married Mary Louise Middleton, daughter of Dr. W. D. Middleton, of Davenport, Iowa. One of their sons carries on the family name; he is Samuel Craig Plummer III.

IT IS to be said of titles that they sometimes mean something. As to railroad service, the "sometimes" should be read "nearly always." In railroad surgery one of the meanings of Chief Surgeon is inevitably that the man who becomes the Chief must first be the Surgeon. Dr. Plummer was, and is, the Surgeon. There isn't anything in his profession, any more than in other professions, that invests its practitioners with the indicia of their work; all kinds of men are surgeons, and rarely, away from the arena, do their appearances bespeak their occupation. But Dr. Plummer *looks* the Surgeon. In manner, movement, expression, culture, he is nothing else—and, as we had occasion to remark some time ago, there can be nothing more. This is the result of a lifetime of intensive interest of heart and mind, applied to the business of *being* a Surgeon. And so, when he leaves the Rock Island Chief Surgeon's office, and goes down to North Carolina for the summer, he isn't retiring. He is only changing scenes—taking with him all that made him Surgeon and Chief Surgeon, now at fortunate fruition. Maybe he will write. He has written—much more precisely than extensively, and thus his more important articles are real contributions to the literature of surgery. Some of these have intriguing titles.* But whether he writes, or rests, or fishes or bowls, or golfs, he won't rust—the metal of his being is too finely tempered for that.

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Hydrocele

—*Its Treatment by the Injection Method*—

by

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THE injection treatment of hydrocele* is one of the oldest methods of treatment that has been advocated, and up until the last 15 or 20 years was probably the method most commonly employed. No doubt many of the older members of this association have had personal experience with this form of treatment. In a previous publication, the authors and others have reviewed the history of this form of treatment, and it is mentioned here only to show that the method was widely used, excellent results being claimed by many. Iodine and phenol were the drugs most commonly injected. At the outset, therefore, we wish to make it clear that the treatment as advocated by us is a radical departure from that which has been previously employed in that the quinine solution which is injected is the same solution which is commonly used in the treatment of varicose veins; and in view of the available reports at present, we feel that the method should warrant our further attention and use in a sufficient number of cases to establish its value. Some men state that abscess and sloughing are very apt to follow the injection treatment as advocated by us. In the hands of the inexperienced, no doubt such accidents will happen. It is our opinion, however, that such accidents will occur only as the result of a very improper technique.

In recent years, several writers have reported using the various solutions commonly employed in the treatment of varicose veins for the injection treatment of hydrocele. Their results were very encouraging. Floyd and Pittman treated 24 cases of hydrocele by injection, using different solutions. They believe that the method is applicable to selected types of hydrocele. Blavier treated 18 cases using a quinine solution, and reports a cure in all cases. He stated that there was little danger in the procedure even though some of the solution was injected outside the sac.

Kilbourne and Murray, after extensive experiments with many of the preparations now advocated for the obliteration of varicose veins, concluded that a solution of quinine, hydrochloride and urethane was the most suitable for the injection treatment of hydrocele. They stated that such a solution should meet the following requirements:

1. It must be painless;
2. It must not cause disability;
3. It must be sufficient to destroy all of the hydrocele without recurrence;
4. It must not be dangerously toxic;
5. It should be bactericidal;
6. It must not subject the patient to danger of hemorrhage into the sac following injection.

We have suggested that there should be little danger from the solution of injury to the testicle or epididymis. Kilbourne and Murray reported excellent results in the treatment of 35 hydroceles.

Hydrocele is comparatively common and occurs in approximately 2 to 4% of the urological admissions to the average hospital, and occurs in several different types. As yet, no definite cause of hydrocele has been established. It is thought to arise from an interference with the lymphatic or blood supply to the scrotal contents, which theory has considerable support. Caforio has suggested that in view of the low specific gravity and smaller serum content of transudates, hydrocele fluid is an exudate of inflammatory origin. Chwalla, in a recent study of a small series of hydroceles, states that although the fluid was invariably free of organisms, the frequency of tuberculosis in the personal or family history suggests tuberculous infection as a common cause of the condition.

Huggins and Entz studied the problem of absorption from normal tunica vaginalis testis, hydrocele, and spermatocele and point out that there is a constant interchange of fluid within all serous lined cavities, and any accumulation of fluid must be due to an imbalance either of secretion or absorption in this interchange. The chief factor involved in hydrocele has not, as yet, been determined. They found a marked delay in the absorption of dye from a hydrocele as compared to the normal tunica vaginalis which, to them, seemed to indicate that delayed absorption may be the chief factor in the accumulation of fluid in this condition. The pathological findings in our case, in which we were able to examine the tunica following the injection treatment and which will be referred to later, would tend to support the findings of Huggins and Entz.

Diagnosis of hydrocele is seldom difficult. In some instances, however, the differential diagnosis may be confusing. Before attempting any type of treatment, hydrocele must be differentiated from the following:

1. Hernia;
2. Gumma;
3. Hematocele;
4. Spermatocele;
5. Chylocele;
6. Neoplasm.

Hydrocele occurring in association with tumors and tuberculosis will be referred to subsequently.

During recent years, open operation for the cure of so-called chronic idiopathic hydrocele has been almost universally employed except in those cases where surgery was not avisable under any circumstances. Most physicians and surgeons consider the surgical treatment relatively simple and effective, which assumption would not seem to be borne out by the fact that many different types of operations have been proposed and recurrences do occur, according to Sanford, 5% of those in whom radical operation has been performed.

The very excellent paper by Campbell is the only thorough analysis of any large series of hydro-

* Read before American Association of Railway Surgeons, November 14, 1935, Chicago, Illinois.

celes that has been reported in recent years. It lacks only a follow-up section with reference to recurrences to make it complete, which, however, was not possible in view of the class of patients involved. Campbell states that the periodic occurrence of disabling postoperative sequelae was one of the principle reasons for making the analysis of the 502 cases of hydrocele which occurred in 456 patients and operated on by 29 different operators on the Bellevue Hospital service. In his series the average hospitalization was 6.1 days in clean cases and 9.3 days in infected cases. He noted an incidence of infection, either superficial or deep, in 15% of the operative cases. Hemorrhage occurred commonly, and in six cases there was an uninfected hematocele and 12 cases of infected hematocele, in eight of whom the testicle became involved to the extent that orchiectomy was performed. Campbell was able to examine only 33 of the 456 patients, and in two of the cases there was definite recurrence and one reoperation was performed. Other observers also report difficulty with hemorrhage. Page states: "In hospital practice, I have been struck with the number of troublesome hematoceles which result from either type of operation in long standing cases."

It is not our intention to attempt a comparison of the injection treatment with the surgical treatment, but we quote Campbell's article simply to show that surgical treatment of hydrocele is not so simple nor free from complications as has been generally supposed. We believe that if any other large series were studied with the same care as was Campbell's series, similar findings would occur.

One of the principal objections to the injection treatment of hydrocele has been the possibility of overlooking coexisting pathology. However, with care exercised in the history and physical examination, this possibility of error should be reduced to the minimum. Campbell found one malignancy in 502 cases operated upon for hydrocele. Generally speaking, the association is not common and should offer no real objection to the injection treatment. However, if the aspirated fluid is bloody, operation should be indicated. The unusual malignancy, associated with a clear hydrocele fluid, should be detected by palpation of the testicle following aspiration. In a case where thickening of the tunica does not allow for adequate palpation of the testicle following aspiration of the fluid, operation should be advised. Tuberculous epididymitis associated with hydrocele may also be confusing. This is also a rather rare clinical picture. Kilbourne and Murray found one case in 87 hydroceles treated, and in this case diagnosis was made prior to operation. In other cases which they traced, in which hydrocele and tuberculous epididymitis were associated, the diagnosis was always evident. Sargent and Marquardt have had two cases of tuberculous epididymitis with hydrocele in which the diagnosis was evident and operation was performed.

The danger of injecting these solutions into the peritoneal cavity is to be considered. Again, however, this association is also quite rare. Kilbourne and Murray found two cases of congenital hydrocele in a series of 231 cases. In both instances there was an associated hernia. They concluded that in the adult, in the absence of hernia, the danger of putting into a hydrocele sac a solution which might pass into the abdominal cavity is extremely slight, if it occurs at all. The danger of introducing infection into the hydrocele sac must, of course, be carefully considered. Kilbourne and Murray, in their experimental work, found quinine and urethane solution highly bactericidal. Sodium morrhuate solution they felt was not suitable for injection because it is nonbactericidal. However, with 0.5% phenol added, this objection is overcome.

Technique

THE scrotum is washed with soap and water, the area pointed with tincture of iodine, and the point of puncture infiltrated with procaine hydrochloride. An 18 or 20 gauge needle is introduced by tunneling under the skin. This is done to prevent leakage of the quinine solution. The needle is introduced well into the sac, as when it is emptied the point of the needle is apt to pull out of the sac. At the present time we are working on the development of a trocar together with the use of a two-way stop-cock which makes aspiration and emptying of the hydrocele sac relatively easy even through such a small gauge needle. The fluid is thoroughly aspirated and the scrotal contents palpated for evidence of tumor or tuberculosis. The fluid is examined microscopically for pus or blood. Two cubic centimeters of quinine hydrochloride and urethane usually have been the initial dose. Fluid usually accumulates after the first injection. The treatment is then repeated in one week, at which time the amount of the quinine solution is increased to 3 or 4 cc. depending upon the size of the hydrocele. If, following the second injection, the fluid reaccumulates and is not spontaneously reabsorbed within three weeks, the treatment is repeated. Should the fluid again accumulate, three weeks' time is allowed to lapse at which time the treatment is repeated. In many cases, one injection usually suffices. However, two, three, or four injections may be necessary. The reaspirated fluid in most cases is hazy and contains fibrin. At the end of a week, if the testicle is moved in the scrotum, there is a crepitent feeling not unlike the friction rub in pleurisy. Should epididymo-orchitis occur, as it did in five of our cases, the time interval between injections is lengthened to allow the inflammatory process to subside. A subsequent injection in one case caused no recurrence of the epididymo-orchitis.

We have injected a total of 64 hydroceles in 58 patients. One of us (G.H.E.) has injected 23 hydroceles in 19 patients. In this series one case has been followed for two years and seven months with no evidence of recurrence. This hydrocele had been tapped several times previously and one month prior to beginning of treatment. Of the remaining cases a bilateral one, a transient patient, left the city after four months, at which time there was no evidence of recurrence. The others are still either under treatment or observation which extends over a period of a few months to two years—several over a year and one-half, and several over one year. All are apparently cured with the exception of one case who has not reported for examination but writes that he thinks there may be a small collection of fluid.

All of the patients have been treated as ambulatory with the exception of one from whom 1200 cc. of fluid were aspirated. This patient was hospitalized over night. In four or five instances pain following the first injection was severe enough to require aspirin by mouth. In one case there was

a moderate reaction to quinine, the patient stating beforehand that quinine by mouth would produce dizziness, ringing in the ears, etc. This hydrocele was of five years' duration, following an epididymitis which occurred after prostatectomy. There was a history of recent trauma, and the patient presented an acute epididymitis and evidence of inflammatory reaction in the hydrocele at the time of the first observation. Simple aspiration was done, and a week later the hydrocele fluid had again accumulated but was found to be clear on aspiration. Two cubic centimeters of quinine solution were injected. There has been no evidence of recurrence in 15 months following the single injection. This hydrocele had been tapped several times prior to treatment.

In three cases epididymo-orchitis followed the third injection, and in all cases rapidly subsided with no evidence, as yet, of reaccumulation of hydrocele fluid. In the one case the hydrocele previously mentioned, containing 1200 cc. of fluid, was given 8 cc. of quinine and urethane solution at the third treatment. He then walked three miles to his home. Follow-up examination of this case showed thickening of the tunical structures and the skin of the scrotum with a grade 1 enlargement of the testicle. Examination on October 21, 1935, or one year and nine months following the beginning of treatment, revealed the scrotal skin to be normal on both sides, no evidence of thickening in either tunica, and both testicles normal in size and position. In another case, the patient—a farmer—following the third treatment drove 25 miles and did his usual work the same evening. The third case had recurrent attacks of epididymitis following prostatic resection, the hydrocele developing subsequent to these attacks. Following the first injection, epidymo-orchitis developed which gradually subsided.

In the three cases, pain and tenderness were only mild or moderate, not being nearly as marked as in the ordinary case of epididymitis. While the patients were advised to stay off their feet, they were not incapacitated, and no patient had temperature at any time he was observed by me.

One case, a bilateral hydrocele, had been operated on on one side 14 years previously. This recurrent hydrocele responded nicely to the injection treatment with no evidence of recurrence after 18 months.

A study of recurrences following operation has shown that in the majority of instances the recurrence occurs soon following operation; a similar impression is gained of the injection treatment. Naturally, however, the cases should be followed over a period of years in order to determine the value of the method as a permanent cure.

Two of us, (C.R.M. and J.C.S.) have injected 41 hydroceles in 39 patients. All except two are apparently cured. These will be referred to later. One case has been followed for 23 months, and the majority for over one year. In this series six were done, using sodium morrhuate solution with 0.5% phenol added. The technique employed was the same as with the use of the quinine solution and the end results the same.

The shortest duration of a hydrocele in this series was six months and the longest 17 years. The fluid in all cases was clear and contained a few lymphocytes and endothelial cells and occasionally spermatozoa. Two cases followed gonorrheal epididymitis, another the repair of hernia, and two followed injury. In the remaining cases, the cause was unknown.

One of the cases had been tapped and injected seven years prior with iodine and an acid preparation. He received one treatment with quinine hydrochloride and urethane with apparent cure. One of the cases, a boy aged six, had an idiopathic hydrocele of eight months' duration. He had been operated on twice for the hydrocele six and seven months prior to injection. Thirty cubic centimeters of fluid were aspirated, examined for tubercle bacilli, and found negative. One cubic centimeter of quinine and urethane was injected. The next day there was an epididymo-orchitis with marked tenderness. With support and heat, recovery was uneventful. At the present time, more than one year following the treatment, there is a small amount of hydrocele fluid present which the mother states has very slowly increased. However, in view of the amount present, one of us (C.R.M.) has advised further observation before resorting to a repetition of the treatment. One other case of epididymo-orchitis occurred but did not require hospitalization.

Lacking specific information from the literature, we gathered this treatment would produce an obliteration of the sac by fibrous tissue formation. We have not followed our cases over a long enough period to be sure of this tissue change. However, we gained consent and opened up the cavity of the tunica vaginalis in one patient one month after the last treatment. He had had three treatments with quinine hydrochloride and urethane and was clinically cured.

The sac was not obliterated. There was a small amount of dark amber fluid and several long loose strands of attached and organized fibrin. Grossly, the testicle and epididymis appeared normal. Microscopic sections of the tunic wall showed the endothelium to be intact. The blood vessels appeared normal, though the subserous tissue of the tunica was distinctly thickened and infiltrated with organizing fibrous tissue. From this study we suspect that the resulting fibrosis of the tunic wall following injection so interferes with the blood and lymph supply of the endothelium that in some way it alters the process of fluid formation or reabsorption.

There has been one recurrence, a patient with a moderate sized hydrocele (150 cc.) with recurrence after one month's observation. He had had seven treatments at weekly intervals. No further injections were given and open operation was resorted to as contemplated employment required that the hydrocele be eliminated before the patient entered upon his duties.

At operation the testicle and epididymis were grossly normal and microscopic study of the tunica vaginalis showed a normal endothelium and some subendothelial fibrosis.

One other patient has been operated on subsequent to the injection treatment. This case will be reported somewhat in detail, as it is the opinion of one of us (C.R.M.) who observed this case on several occasions, that further observation and injections could have been employed in this case before resorting to surgery.

A white male, aged 45, married, with an idiopathic right-sided hydrocele of about eight months' duration, entered the Milwaukee County Dispensary on June 28, 1935, and had a simple tap of the hydrocele with removal of 650 cc. of clear fluid.

The urine, routine blood and Wassermann examinations, etc., were negative. A note at the time states that the sac did not transilluminate well and that the testicle was palpated with some difficulty. The tunica was thickened and described as "leathery." Following the simple tap of the hydrocele, the fluid reaccumulated, and on August 6, 1935, and again on August 13, the hydrocele was tapped and 2 cc. of quinine hydrochloride and urethane injected on each occasion. On August 17, 1935, the hydrocele was tapped, 175 cc. of dark amber fluid withdrawn, and 2 cc. of quinine hydrochloride and urethane injected. Again on August 24, 1935, he was tapped and 300 cc. of dark amber fluid removed, followed by the injection of 2 cc. of quinine hydrochloride and urethane. On August 31, 1935, the hydrocele was tapped, 150 cc. of fluid withdrawn and 2 cc. of sodium morrhuate injected. On September 3, 1935, in the absence of any untoward symptoms and without allowing adequate time for the determination of the subsequent course, the patient was seen by one of the attending men who is unfavorable toward the injection treatment, and operation advised, which was promptly done.

At the operation, the testicle was found imbedded in a thick sac. The pathological examination, in part, states that the testicle is 4½ cm. in length and 3 cm. in thickness, light brown in color, firm in consistency. The external surface of the tunica is smooth and grayish-white in color, the internal surface covered with a yellow, fibrinous exudate. The sac is 4 mm. in thickness. Microscopically there was atrophy of some of the tubular apparatus of the testis and proliferation of strands of connective tissue between the tubules. The connective tissue shows evidence of hyaline degeneration and areas of lymphocytic infiltration. On one side the testicle is highly vascular, containing some hemorrhagic areas with lymphocytic and leucocytic infiltration.

We believe there is some justification to doubt whether this partial atrophy was due to the injection treatments, as prior to the treatment there was thickening of the sac and there must have been some connective tissue present before injection.

From a clinical standpoint, an operation was not imperative, the only recorded complaints being that the fluid reaccumulated with a sense of discomfort and dragging in the scrotum.

Resume

THE injection treatment of 64 hydroceles in 58 patients by quinine hydrochloride and urethane and sodium morrhuate is presented. While our series is too small to draw any definite conclusions, the results are encouraging. There have been three cases classed as recurrences. The longest period of clinical observation after injection has been 31 months.

2. Epididymo-orchitis followed the injection in five cases with no apparent deleterious effects. No other serious complications occurred.

3. The injection treatment may be employed in simple chronic hydroceles or in recurrent hydroceles. It is contra-indicated in congenital hydrocele if there is suspected communication with the peritoneal cavity. It is contra-indicated where pathology in the testicle or epididymis is suspected, such as tumor or tuberculosis.

4. Quinine hydrochloride and urethane probably does not act by obliterating the sac but rather by altering the process of fluid formation or reabsorption.

Discussion:

DR. MURDOCH BANNISTER, Ottumwa, Iowa: Is this operation applicable in infancy? We have a great many hydroceles in young infants.

DR. JAMES C. PATTERSON, Marengo, Iowa: I would like to ask Dr. Ewell if he considers it necessary to wash out the sac after aspiring the fluid and before injecting the sclerosing fluid. What is the dose of the sodium morrhuate? Is it larger than that of quinine urethane?

DR. JOHN F. HASSIG, Kansas City, Kan.: What are the advantages of the quinine solution over the phenol?

DR. GEORGE H. EWELL, Madison, Wis. (closing): Hydrocele in infants is quite common. Under ordinary circumstances, simply tapping and emptying of the hydrocele will result in a clinical cure. We have had only one boy, age six years. However, one of my colleagues injected a child of 14 months. I see no contra-indication to the treatment in infants and young children. The only difference naturally would be to decrease the amount of quinine solution used. One other danger is to be sure that you are not dealing with a congenital hydrocele.

We do not wash out the sac. That was advocated many years ago when phenol was the medium injected.

The quinine urethane solution is put up in ampules and is the same solution that many men use for the treatment of varicose veins. The simplicity of the method is what recommends it.

As to the advantages of quinine urethane over phenol, we have never seen, except in two cases, the reaction consisting of swelling and tenderness, which were so common when phenol was used in previous years. In view of the fact that quinine has been employed so extensively in the treatment of varicose veins and that it can be used apparently safely intravenously, we should be able to use the same solution in the hydrocele sac. Furthermore, we do not believe any longer that the cure of the hydrocele depends on the sclerosing of the sac. We think the result comes from changes in the blood vessels and lymphatics which occur with the quinine solution. Since the publication of our series of cases by this method, I have had many communications from men who tell me they still employ phenol commonly in the treatment of small hydroceles.

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Ankle Joint Fractures

—Principles and Treatment—

By FRANK D. DICKSON, M.D., F.A.C.S.,
Kansas City, Mo.

WHEN we discuss fractures of the ankle joint* we are reopening an old chapter in surgical history and yet one which seems strangely new to each succeeding generation, and one which, I believe, now more than ever, is of vital interest. Fractures of the ankle joint must have been familiar to the ancients, but it is from the writings of Percival Pott (1713-1781) and Dupuytren (1777-1835) that we gain knowledge of treating fractures of the ankle joint. Since the writing of these masters—and subsequently a large number of very important communications have been put into the literature and this subject has been so completely elucidated—it seems impossible to add to the knowledge already available to those who wish to acquaint themselves with it. So when I speak of this subject all I can hope to do is to refresh your memory by again calling your attention to the method of production of ankle joint fractures, suggesting a reasonable classification of these fractures, cataloging some important diagnostic signs, and suggesting a method of treatment based on the modern conception of the problems which these fractures present and the modern methods of meeting them.

Fractures of the ankle joint are divided into two groups: fracture of the lower end of the leg bones, the tibia and fibula, and fractures of the astragalus. I shall consider only the first group at this time.

In considering fractures of the ankle joint there are certain anatomical features in the architecture of this joint which should be borne in mind, as they have an important bearing on the manner in which these bones behave when fractured. The ankle joint is formed by the lower ends of the tibia and fibula, and these are bound together by strong, tough ligaments which form essentially a hinge motion in this joint—though that is not exactly true since the tibia does move to a certain extent on the fibula. Strong lateral ligaments pull the astragalus into this mortise and permit little lateral mobility. The external lateral ligaments pass inward, to be attached to the posterior surface of the astragalus. There is no counterpart of this band on the inner side; consequently in all injuries to the joint the astragalus remains attached to, and is displaced with, the fibula. This fact is the key to ankle joint fractures, and should be borne constantly in mind. It was this fact that led Pott and others to make the statement that dislocation of the ankle joint never occurs without fracture of one or both bones. This was what caused Dupuytren to consider the fibula as the pivotal point of fracture in the ankle joint.

* Presented before the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East), Chicago, November 15, 1935.

Method of Production of Fracture

DIRECT violence plays a very little part, only 1%. Indirect violence, acting through the astragalus, tends to produce a breaking strain. There are four forms of indirect violence responsible for ankle joint fractures. The first is external rotation; second, abduction or eversion, third, adduction or inversion, and fourth, upward compressive thrust against the ankle mortise.

In the first form of violence, external rotation, a twisting strain is applied to the foot so that it rotates externally along the ankle and the force is transmitted to the fibula in the form of a traction strain, and fracture, either spiral or oblique, results. There is little tendency to diastasis of the tibia and fibula in this fracture. If the force continues we have fracture of the tibia and fibula.

In abduction fractures the astragalus rolls upward in the tibial mortise and exerts tension on the internal lateral ligaments; and the most common sequence of this is tearing of the internal lateral ligaments, the fibular fracture occurring secondarily. This fracture may occur low down, when it is usually transverse; or high up, when it is usually oblique. Diastasis of the fibula and tibia, which is important in any ankle fracture, does not occur to any extent in low fractures but does in these high fractures.

In adduction fracture the mechanics are the reverse of the ordinary abduction type. The astragalus rolls inward and tears off the external malleolus, a fibular fracture. The continued thrust of the astragalus against the internal malleolus causes it to fracture secondarily.

In upward compressive thrust against the tibial mortise we usually have an injury which takes the form of a fall from a height sufficient to cause an impact against the lower end of the tibia. When this occurs a triangular piece is broken off the posterior surface of the tibia, and there is a fracture line running down into the joint. This fracture does occur alone, but is usually associated with fracture of the malleoli. In this fracture it is well to remember that the triangular fragment is displaced with the astragalus and fibula and not with the tibia. A lateral displacement occurs, but the main displacement is a posterior one. This is sometimes spoken of as a posterior marginal fracture.

There has been some investigation as to the relative frequency of occurrence of these various injuries. The most authoritative is that of Ashhurst, who gives the following figures:

External rotation fracture	61
Abduction fracture	21
Adduction fracture	13
Marginal fracture	19

Kellogg Speed's figures run about the same. I think the posterior marginal fractures are about the most important.

I would like to discuss the classification of ankle joint fractures. In a fracture as complicated as that of the ankle joint it is justifiable that some form of classification be adopted. It is only in that way, naturally, that discussion can be avoided over what is meant by this or that fracture. In other words, it is desirable that we all speak the same language.

There are a number of classifications suggested; a historical one in which some surgeons use the

Potts' and Dupuytren's classification. This is favored by Ashhurst. Probably the most satisfactory classification is one based on the anatomy. The one that I use is based largely on Platt's classification, which in turn is based on the larger one of Thompson:

A.—Fractures of the Malleoli:
1. Isolated
   a—Fibula.
   b—Internal malleolus.
2. Combined
   a—Low bimalleolar without displacement of astragalus.
   b—Bimalleolar with displacement of the astragalus (Potts-Dupuytren fractures).

B.—Fractures of the Weight-Bearing Surfaces of the Tibia:
1. Isolated
   a—Posterior marginal fractures.
   b—Anterior marginal fractures.
2. Combined
   a—Anterior or posterior marginal fractures associated with fracture of the malleoli.

Diagnosis

AS TO diagnosis, it is unnecessary in a gathering of this kind to discuss symptoms. There are certain things I would like to emphasize. First, that the history of an injury about the ankle joint in which a twisting or bending strain has been applied, should always be extremely specific. The position is typical. The foot is held in plantar flexion and eversion, and the external malleolus is always prominent. Of course, preternatural mobility and crepitus are prominent signs. There are two signs in posterior marginal fractures, as pointed out by Cotton, which are important: first, undue prominence of the tibia in front, and second, undue mobility of the ankle joint, so that even after reduction there is a marked tendency for deformity to occur. Finally, and perhaps most important, we have the x-ray. I cannot over-emphasize the necessity of taking x-rays in injuries about the ankle joint with swelling. It is almost unnecessary to mention that they should be taken in both planes. In certain external rotation fractures you cannot see the fracture of the fibula in the anteroposterior view, but it is very clear in the lateral view.

The diagnosis is extremely important in ankle fractures as in fractures in the vicinity of the ankle joint, because of the grave interference with an important weight-bearing joint if these cases are not correctly diagnosed and given adequate treatment. It is especially important that care in the diagnosis be emphasized in those ankle joint injuries in which we have lesser degrees of displacement. It is this type of case that is overlooked, to the detriment of the patient and the reputation of the medical attendant. In fractures accompanied by gross displacement we usually find the diagnosis adequately made and the proper treatment instituted.

I should like under diagnosis to say some particular things about posterior marginal fracture. From my experience it would seem that in quite a large number of cases the posterior displacements are either not recognized or the importance of overcoming the posterior dislocation of the ankle and the restoration of the ankle and the weight-bearing surface of the tibia is not appreciated. If this is not done, when healing occurs you will have a posterior displacement of the leg. Flexion and extension of the ankle will be seriously interfered with, resulting in a painful ankle and permanent disability.

Treatment

THE routine treatment of fracture of the ankle in our clinic is the immediate reduction and application of a plaster cast. Reduction of all ankle joint fractures should be carried out under anesthesia, general or local. The reduction is accomplished with knee flexion, the lower end of the tibia and fibula grasped with one hand, the fingers being just above the proximal part of the internal malleolus, and the distal part grasped with the other hand, and the foot forced inward and inverted. It is important in making this reduction that the posterior part of the foot is adducted and inverted, and not merely the anterior part, because the fragments are controlled by the posterior part of the foot and not by the anterior part. I have never seen any harm come from too much inversion, but a great amount is not usually necessary. If there is a posterior displacement of the ankle it must be corrected by appropriate manipulation. If the fracture is an adduction fracture, the manipulation is just the opposite. I would like to caution you against putting the foot in a position of persistent flat foot. The important objective in reducing ankle joint fractures is accurate restoration of the ankle mortise. If this mortise is not corrected, when healing has occurred you have a faulty weight-bearing line of the ankle joint. A grave disability results, namely, the inability to bear weight without pain, a disability which can only be overcome by operative interference and usually means an arthrodesis of the ankle.

When reduction has been secured, a plaster cast should be applied and immediately bivalved. The foot is held in right angle flexion, or as close to it as seems desirable. Such a bivalved plaster cast provides for the swelling, allows inspection, and holds the fragments firmly in place. I know that many competent surgeons prefer after reduction to put the ankle in some form of splint and wait for a week or two to have the swelling subside. It is our experience that there is much less swelling and it disappears more rapidly if the fracture is immediately immobilized. All surgeons agree that some form of fixation is necessary. I believe an ambulatory splint should be used only in large clinics, and not adapted to individual use.

The after-treatment should be the removal of the anterior part of the plaster and then gradually the entire cast in two or three weeks, and active motion permitted. Weight-bearing may be permitted in six or seven weeks, sometimes earlier, on crutches with the shoe elevated three-sixteenths of an inch on the inner side to maintain the inverted position of the foot.

Again I am going to come back to the posterior marginal fractures, because these fractures have certain features which in my opinion require special care in the management to avoid disaster. The reduction of such fractures should be carried out in the following manner. The lateral displacement should be corrected after the method I have just discussed. That is the first step, and, since

the triangular fragment follows the astragalus and fibula into displacement, before doing anything else. The foot should not be brought up to a right angle. When the lateral displacement has been corrected, the foot should be drawn forcibly forward and brought up into complete dorsal flexion. Such dorsal flexion holds taut the posterior ligament of the ankle joint which molds the triangular fragment back into place and tends to hold it there. This should all be done with the knee flexed to relieve tension on the tendo Achilles. When the reduction has been made, a plaster cast should be applied with the knee in moderate flexion. The cast should extend above the knee and be allowed to remain on for two or three weeks. I do not believe it is safe to allow any tension on the heel tendon. At the end of three weeks the cast should be cut down, though I do not believe that weight-bearing should be allowed as early as in uncomplicated malleolar fractures.

The other point about these fractures that I should like to emphasize is that, even after reduction, displacement can and does occur in the cast. Therefore, even if you have secured a satisfactory replacement of a posterior marginal fracture, it is wise to check up the next day and the next day, and then every two or three days to be sure fixation is being maintained—in fact, we check up four or five times in the first 10 days. When we have had displacement after reduction, I have used the following method to hold the fracture in place and prevent its displacement. A plaster cast is applied to the leg from above the knee joint to the ends of the toes, and well padded over the lower margin of the tibia. The plaster is then cut out from the lower margin of the tibia to the ends of the toes, leaving the uncut cast from here up. A Kirschner wire is run through the astragalus and traction made upward, in reality forward on the foot. I have used this method in only five or six cases, but they have come out satisfactorily.

If accurate reduction cannot be secured by conservative methods, open reduction is indicated, but only by those who are fitted to carry out this intricate procedure. It sounds simple, but it is a difficult and sometimes hazardous procedure.

The treatment of malunited fractures of the ankle is a question which comes up quite frequently. Here each case is a problem in itself, and requires a procedure which is best adapted to care for the pathology present.

Summary

IN CLOSING, I should like again to emphasize that fracture of the ankle joint is a serious fracture in that it involves the function of an important weight-bearing joint, and is a matter of considerable concern to the average wage earner. I do not feel it is particularly important that brilliant or fortunately placed surgeons can point to a good series of excellent results. I do think it is of great importance that the caliber of treatment everywhere be of such excellence that a large percentage of useful and well functioning ankle joints may result for the wage earners of our country. One hundred years ago the dictum of Dupuytren, that under the most favorable circumstances ankle joint fractures leave behind a deformity which makes progress quite painful, may have been justified. Today with the x-ray and modern facilities for treatment it certainly should not be so.

The Injection Treatment of Hernia

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ALTHOUGH attempts have been made to treat hernias by injection for over 100 years, the present modern method is of comparatively recent origin.* Sufficient clinical and experimental evidence has developed, however, to establish quite definitely certain phases of the subject, whereas there are certain other features which remain for the future to determine.

Owing to the increasing interest being displayed by prospective patients, it behooves all physicians to be informed on this subject so that they may fairly answer queries from patients as well as from corporations and insurance carriers. Certain influential medical journals have voiced opposition which appears prejudicial because it seems to be based neither on a careful appraisal of all the available facts nor on direct personal experience while, on the other hand, there are proponents who have waxed too enthusiastic over the method.

Recent technique, it appears, is veering strongly toward the use of the milder, relatively nontoxic, solutions which can be injected in doses of 1 to 5 cc. These preferred solutions cause a fibrous proliferation but no necrosis. The danger from the possible (but really inexcusable) intraperitoneal or intravascular injection is very greatly reduced. Of course, the simple expedient of withdrawing the plunger both before injection and several times during the injection should make this risk almost negligible.

Less optimism is being exhibited concerning the length of time the truss should be worn. Though the time required varies with the type of hernia and the patient's age and occupation, it seems that a period of at least six months is advisable in an active or laboring man.

During the first month it should be worn scrupulously both night and day.

Careful fitting of the truss and the patient's complete cooperation in wearing it correctly are very important requisites.

In the obese, reduction of weight before and during treatment greatly enhances results.

A careful follow-up record should be kept of all patients so treated, in order that more accurate statistics of end-results will be available.

I believe the recurrence rate will prove to be considerably higher than many are led to believe. Accurate statistics are hard to obtain because of the insufficient length of the elapsed time and because of the inadequacy of the follow-up examinations. In addition to the actual clinical recurrences there are other instances where there is sufficient absorption of the fibrous tissue so that if one re-examines these patients at intervals he will find instances of bulging which must be classed as recurrences even though the patient has no objective complaint or knowledge of it. My estimate would be a recurrence rate of 15 to 20%; perhaps the tendency toward the gradual increase in this rate as time passes may be compensated partially

*Presented at the Clinic of the Institute of Traumatic Surgery, March 13, 1936.

by the recent improvements in technique. It is also true that, on a comparative basis with surgery, since the injected cases are usually moderately well selected (except in the aged and in certain unfavorable instances where there are contra-indications to surgery), one might expect a more favorable recurrence rate in injected patients. However, the recurrences are usually small and, in most instances, respond favorably to a second period of injections and truss wearing. The reapplication of a truss in one recent recurrence of mine has caused too much soreness, so he will have to be operated on. Many post-operative recurrences can be satisfactorily handled by injections. Some patients who have had one surgical operation for hernia are averse to a second operation.

LIMITATIONS to the applicability of the method should always be borne in mind. It is best in small or moderate-sized indirect or direct inguinal hernias, somewhat less applicable in femoral, and much less in umbilical hernias. Incisional and post-operative abdominal hernias are usually best handled surgically. Fairly large inguinal hernias are sometimes benefited to a surprising extent, but these may need bed rest for the first seven to 10 days. Of course, irreducible, strangulated, sliding, and hernias with undescended testicle, form contra-indications. Nor is the method applicable unless the truss keeps the hernia completely and painlessly reduced. If there is any question as to the complete reduction of the hernia it is best not injected.

Certain disadvantages to the method, both actual and alleged, may be cited. The prolonged wearing of a truss is irksome (although many hernia sufferers have worn trusses for years). The relatively higher recurrence rate has already been mentioned. Employers and insurance carriers may react unfavorably to this and to the less definite nature of the outcome because of their disinclination to re-open a closed case for a possible subsequent series of injections. The length of observation and treatment is looked upon with disfavor by some. The alleged lack of a permanently strong wall, with fibrous absorption in time, is a question for the future to determine. There is a variation in the reaction of the tissues of individuals both during and after the injections; perhaps this is the same type which does not develop a firm post-operative wall.

Some serious complications have been reported in the literature, and, although apparently due to gross neglect and carelessness in most instances, their occurrence alone is sufficient ground for demanding the requisite skill and careful technique. Abscess or slough have been unknown to me, but their reported occurrence chiefly from the older caustic solutions would indicate strongly that the use of such solutions be relegated largely to those well experienced in their use. Small cord hydroceles, cord swelling, local reaction at injection site, and small hematomas occur but usually subside spontaneously.

The question as to the actual cure of the hernia because of a persistent sac is of interest. Some patients have been operated on following a few injections and an obliterated sac found; in other instances there was a persistent sac with a fibrous accumulation blocking it from the external ring. There is no definite knowledge as to which of these two possibilities is most frequent. If, in the future, the injection method continues to give many of these patients freedom from discomfort or clinical evidence of hernia, the important criterion will have been met. If a persistent sac is the rule, one should expect increasing evidence of discomfort, bulging, recurrence, and complications such as strangulation.

THERE are certain advantages in this method which are manifest. The treatment is ambulant; loss of time from work is rare, even in heavy labor. This saving, when added to the saving of hospital expense, is substantial. The financial status of many is such that they would have to enter a charitable institution in order to be operated on, and even then the loss of time is serious.

Many applicants for employment are rejected by a pre-employment examination disclosing wide rings, bulging, or potential hernia. These can readily be injected, enabling the applicant to be accepted for employment.

The mortality and morbidity of the ambulant method are extremely favorable. It is a boon to many aged individuals and poor operative risks. Certain incapacitated persons can be relieved (even if not cured) and be returned to work. And it should not be overlooked that this method brings the mechanical treatment of hernia into the hands of physicians instead of having quacks, druggists, and others supplying them with trusses and advice.

Frankly, there should be no argument between the surgical and injection treatment of hernia; rather, they should be judged as alternative methods. In many instances surgery is superior; often it alone is indicated. But there is a definite group of patients in whom, either for financial reasons, personal distaste for surgery, or because of the existence of a contra-indication for surgery, the ambulant treatment offers an alternative choice. It is only by a careful, unbiased appraisal of individual and collective experience that the exact future scope of this method can be ascertained.

For purely selfish reasons I enjoy operating on patients afflicted with hernia far more than injecting them, but during the past few years it has been a source of definite gratification to be able to offer and use the ambulant method, especially in individuals in economic straits.

As has been so well stated by Dr. S. W. Fowler: "Surgery is often indicated when injections are not applicable as in strangulated, incarcerated and irreducible hernias. But the injection method is frequently applicable when surgery is inadvisable or contra-indicated as in those seriously debilitated by age or disease. Surgery has recurrences and so has the injection method, but the latter method of treating recurrences is relatively simple, and a threatened recurrence can often be halted by further treatment. Surgery has its dangers and complications with deaths in a small but not negligible percentage. The injection method is singularly free from noteworthy dangers and complications. Which method to use, therefore, should be governed by considerations applying to each individual case. This method should be judged on its practical merits in the light of tested experience. Its economic implications are so great that they cannot long be ignored."

Industrial Medicine

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This Issue

THE American Association of Railway Surgeons has selected INDUSTRIAL MEDICINE as its official publication. The Association is 33 years old. The little glimpse of the circumstances of its beginning, revealed in the short portrait of a surgeon, on pp. 193-194, is eloquent of its serious purpose intended; the paper on "Hydrocele", by DRS. EWELL, MARQUARDT and SARGENT, on pp. 195-199, is eloquent of its serious purpose accomplished. In quality and importance this paper is typical of the scholarly and competent presentations that characterize not only the meetings of the American Association of Railway Surgeons but also the meetings of organizations of railway surgeons in general. Witness the scientific precision of the expressions of DR. METZ (p. 166), DR. MASON (p. 168), DR. KATHERMAN (p. 171), DR. KREUSCHER (p. 185), and DR. DICKSON (p. 199), at the last meeting of the Surgical Association of the Chicago, Milwaukee, St. Paul & Pacific Railroad (Lines East). These are papers of a high order of excellence—and yet they are only of the usual order when railway surgeons get together. These men, of course, have had long experience with the medical and surgical problems of people in employment; their industry, the business of transportation, was a mechanical adult while most of the production of the "machine age" was still in its swaddling clothes. Their acquaintance—and the acquaintance of their executives—with the phenomena of the industrial phases of medicine and surgery, therefore, is so extensive as to preclude much of the naivete with which many of these phenomena are viewed in lines of more recent technical adolescence. Habitually, the railway surgeons observe with a seasoned eye, and weigh with a seasoned judgment. Their responses to presentations which are worth responding to, however, have not lost in spontaneity; they go to their meetings, as a rule, with something to give, and they come away from them, as a natural sequence, with something gained. . . . DR. LASHER writes instructively on "Fractures of the Os Calcis," p. 175, with special reference to the degree of disability to be expected. . . . F. ROBERTSON JONES produces some very significant figures on the costs of occupational disease compensation, p. 179 . . . DR. HOLMBLAD gives the full details of his use of "Pooled Convalescent Serum" in two cases of hemolytic streptococcus infection, p. 163, the article based on his talk at the all-day clinic of the Institute of Traumatic Surgery last month. . . . CHICAGO Society of Industrial Medicine and Surgery's meeting of March 25 is reported in abstract form, pp. 161-163. . . . DR. SLOBE follows up his discussion of the "Injection Treatment of Hernia" at the clinic of the Institute of Traumatic Surgery, March 13, with the article on p. 201. In reporting DR. SLOBE's discussion in our March number, it was said that "the patient should be followed every two years." DR. SLOBE calls attention to the fact that he emphasized the need of examining the patient every two months for a period of at least two years and at intervals thereafter, in order that statistics on this method may be accurate. It was also stated "a truss should be worn in conjunction with the treatment for a period of six months at least in laborers, and it is better used longer than in former experience—in some instances a truss should be worn night and day for one month." Here, the idea intended to be conveyed, is that a truss must always be worn for approximately the first month night and day, and for about six months thereafter during the day, at least in those leading an active life or doing labor. These points are both carefully covered in the article in this issue . . . DR. GEO. H. GEHRMANN, Medical Director, E.I. Du Pont de Nemours & Co., gave a talk on "Industrial Medicine and Toxicology", last Fall, at a meeting of the American Institute of Chemical Engineers. This was later published in *Chemical & Metallurgical Engineering*, with an editorial note which was a little masterpiece of summarization. DR. GEHRMANN'S article is on p. 204 herein. . . . THE paragraph about "lead acetate" in the extract on "Cosmetics", p. 210, gives rise to the thought that the ultimate logic of the trend of compensation adjudications may be like this: A woman worker in a plant process in which lead is used, herself makes use of a hair dye containing lead acetate. She turns up later with lead poisoning—not from the process of her work, but from the dye in her hair. She works with lead, and is lead poisoned. What use is evidence against the *res ipsa loquitur* of such a situation? This is not a bit more far fetched than situations which are the almost daily subjects of decisions against the employer. . . . DR. CASSIUS H. WATSON, Medical Director, American Telephone & Telegraph Co., and Fellow, past President, and now a Director, of the American Association of Industrial Physicians and Surgeons, is also President of National Safety Council this year. The 1936 Annual Meeting of the Association will be held at the same time and place as the Annual Meeting of the Safety Council—at Atlantic City, N. J., October 5 and 6—as announced on p. 209.

Industrial Medicine and Surgery

Industrial Medicine and Toxicology

MODERN civilization demands that we improve the old methods by which workmen were made ill and died by the score, and that we advise adequate methods of preventing occupational poisonings and diseases.* Therefore, it is necessary that chemical engineers and physicians should become more closely associated in order to develop sufficient knowledge concerning these health hazards, and with this knowledge to institute protective measures which will make all plant operations safe.

Industrial medicine is not a new specialty; neither is the recognition of occupational diseases of recent origin. Bernardini Ramazzini, during the 17th century, wrote a treatise on the diseases of tradesmen, in which he recognized many diseases of occupational origin. He defined industrial medicine when he said, "We must own that some arts entail no small mischiefs upon the respective artisans, and that the same means by which they support life and maintain their families are oftentimes the cause of grievous distempers which hurry them out of the world." Compare the simple industrial operations of Ramazzini's time with the complex operations and toxic substances of today and it is obvious that we are facing a complicated problem that must be worked out by the clinician and the toxicologist, as well as the engineer.

What is industrial medicine and how may it be successfully applied? It is not simply the treatment of occupational disease and intoxications, but includes that which is more important — medical methods for the prevention of these diseases.

Occupational diseases occur as a result of exposure to toxic substances and lack of proper medical supervision. Some of these diseases are the results of years of exposure and cannot be cured; for example, silicosis, a disease in which clinical symptoms do not appear until there has been extensive lung damage. Unfortunately, this damage is progressive and incurable. There are industrial diseases that are sudden in onset and terminate in death in a few hours; in this class we have chlorine poisoning, which causes an acute respiratory disease. There are acute occupational diseases which appear almost immediately after exposure, run an acute course for a period of 12 to 48 hours, and clear up in a few days. Aniline and nitrobenzol are examples of substances which cause this type of illness by their action upon the red blood cells, forming methemoglobin, which is followed by the destruction of many millions of the cells. These and other examples of industrial intoxications have developed with the progress of industry and have been recognized as the result of bitter human experiences, inestimable suffering and often death.

Industry must realize that the previous methods of trial and error are no longer acceptable, neither are they economical. Further, we must develop accurate knowledge of health hazards before operations are started. Operative procedures must be designed to prevent toxic exposure, and industrial health must have adequate medical protection.

The toxicologist, by proper methods of animal study, can develop the toxicity of a compound and the mechanism of its action. From these facts he can point out both the precautions necessary for safe operation in the plant and the clinical symptoms which indicate the beginning of poisoning. With this information the industrial physician can establish adequate methods of medical supervision, organized on three basic principles; viz, proper selection of all employees, special medical protective examinations, and treatment of occupational diseases.

Pre-employment physical examination is the only means of making the proper selection of employees. The success of this examination is dependent upon several factors. The examiner must have at least a reasonable knowledge of the working conditions of the plant and the physical and mental requirements of the individual jobs. Job requirements have a wide range of variation. For example, the physical effort necessary safely and efficiently to perform duties may range from physical perfection of 100% down to a very low percentage. The worker who is engaged in lifting heavy materials all day must possess more physical ability than one who maintains temperature and pressure regulations in a chemical operation. Furthermore, the worker who possesses the physical strength to perform laborious work all day may not have the mental requirements that would make him an efficient chemical plant operator.

There are many compounds used in industry which are toxic and under certain conditions may cause sudden death; examples of these are HCN and H_2S. The latter in high concentrations kills almost instantly and, further, these high concentrations cause rapid paralysis of the olfactory nerve with a complete loss of the sense of smell. Therefore, it is possible to walk unaware into a high concentration of H_2S, become unconscious, and die before rescue is possible. Concentrations above 500 parts per million are dangerous.

Other compounds are toxic to a lesser degree, act more slowly and produce chronic disease—some in a short time and others after years of exposure. Lead is an example of the former. Lead gives rise to acute symptoms, depending upon the amount of the daily exposure, in a few days or a few weeks. Then, as examples of those compounds which require years to act, are certain nitro- and amino-compounds which cause simple tumors and cancers of the urinary bladder after an average exposure of eleven years.

Some compounds have a selective action upon certain organs. Carbon tetrachloride interferes with the function of the heart muscle. This action is more severe when the heart muscle is affected by heart diseases. Therefore, an individual with a normal heart muscle may successfully withstand the effects of this substance, but one with a diseased heart muscle may die with acute cardiac failure.

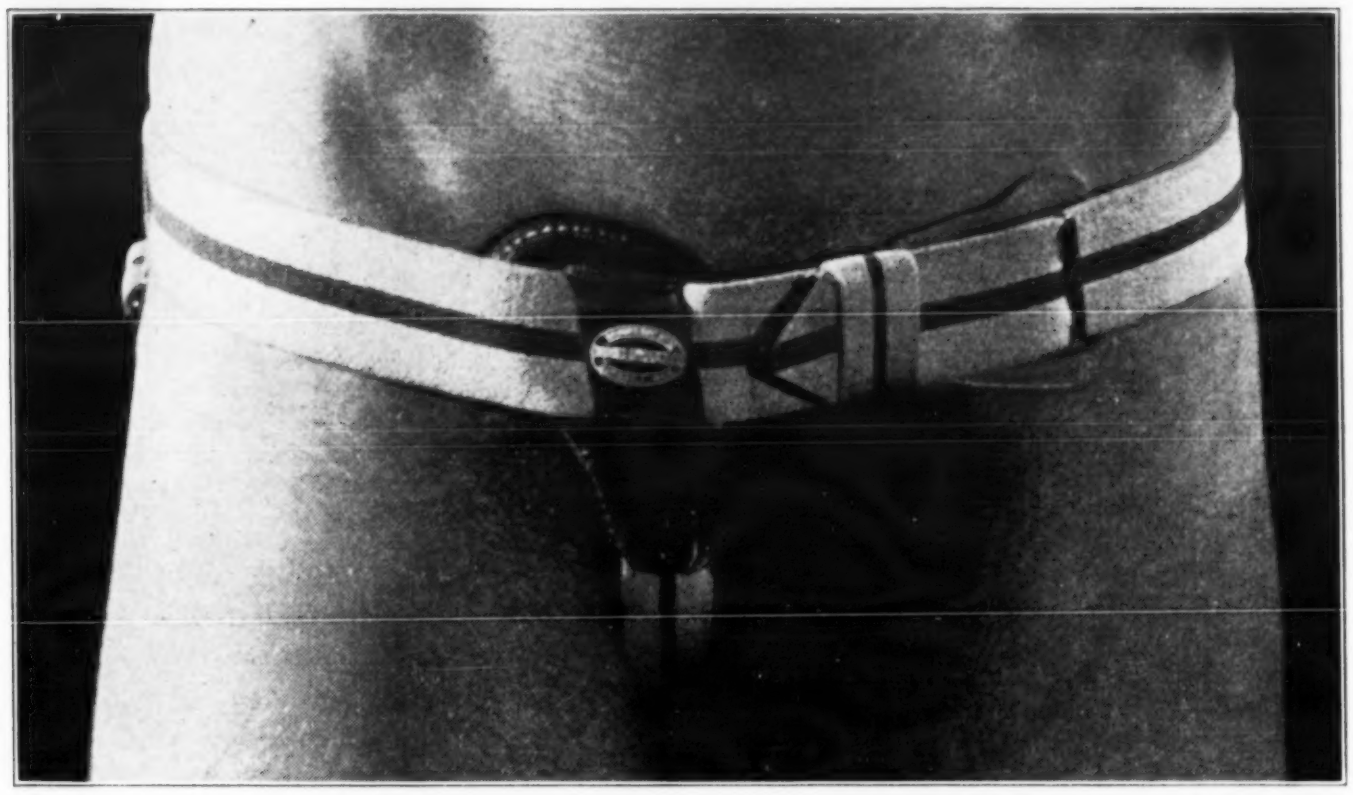
Mercury compounds are eliminated through the kidneys and cause severe irritation with acute or chronic nephritis. Phosgene, nitrous fumes and other irritant gases cause marked inflammation of the lungs and may aggravate a more active pulmonary tuberculosis. Any chronic lung disease may be aggravated to such a degree as to cause acute illness, permanent disability, or death. Organic disturbances of the central nervous system may be aggravated by such compounds as carbon bisulphide and those of lead. Lead intoxication produces an encephalitis, which is almost impossible to differentiate from the mental disease produced by late syphilis.

These are some of the possibilities which must be considered by an examiner in order that he may protect an applicant, who has an already established disease, from working with compounds that will aggravate or activate his condition.

In 1911, the first compensation laws were passed in this country. Prior to this time there were, to the best of my knowledge, no physical examinations in industrial plants. The passage of these laws made industry responsible for accidents and physical disabilities, and the physical examination was introduced as a protection against claims for conditions that existed before employment. At that time applicants were refused employment for even minor physical defects. Later, the compensation laws were amended to include occupational diseases as well as injuries. This necessitated a more complete employment examination and developed the periodic examination as a method of detecting the beginning symptoms of occupational diseases. Experience indicated that respiratory diseases were being frequently missed, the errors in diagnosis being reflected in the incidence of activated lung processes occurring after exposure to irritant gases. Kidney damage was, in a like manner, being overlooked, and cardiac and circulatory pathology either missed entirely or the findings not given the proper interpretations.

THERE then came the realization that physical examinations for industry should be of such a nature as to accomplish two purposes: First, to select applicants and place them in occupations that would not ag-

* G. H. GEHRMANN, M.D., F.A.C.P., Medical Director, E. I. Du Pont de Nemours & Co., Wilmington, Del., in *Chemical & Metallurgical Engineering*, December, 1935; based on a paper entitled "Industrial Medicine and Industrial Toxicology" presented by DR. GEHRMANN, on November, 13, 1935 before the Columbus, Ohio, meeting of the American Institute of Chemical Engineers.



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gravate any existing disease; second, to eliminate the unnecessary exclusion of applicants who, although they presented certain physical defects, were nevertheless able, safely and efficiently, to fill properly selected jobs. In order to accomplish these purposes we realized that we must have more accurate diagnosis at the time of employment.

A medical diagnosis is made by combining what the patient tells the doctor with the findings as observed by the doctor. Both factors are extremely significant and probably of equal importance. Patients present themselves to their personal physician to be cured of an illness and naturally tell of all their complaints. On the other hand, applicants for employment present themselves to the examiner with hopes of passing their examinations and, therefore, have an incentive to cover up any existing illness and conceal many pertinent facts concerning their medical history. This places the examiner at a disadvantage, and so in order to detect lung pathology, liver disfunction, nephritis, cardiac diseases, circulatory disturbances and central nervous involvement, he must have at his command all the modern diagnostic equipment for making urine analyses, blood examinations (including blood chemistry), blood counts, serum examination for syphilis, x-ray films of the chest and, in special cases, electrocardiograms and basal metabolism tests.

Unfortunately, there are too many industries today giving little or no consideration to such an examination and many others making no examination at all. They consider this work unnecessary as long as their insurance carriers give them adequate coverage. Many are unaware of the hazards that exist in their factories, others show no interest until they are forced to become interested, either because of compensation experiences, civil suits, or insurance rates that have increased to such an extent as to be reflected in higher production costs. Too many are satisfied with a superficial examination which costs comparatively little money, does not supply adequate information or protection, gives a false feeling of security and, in truth, is wasted time, money and effort. All too frequently the physicians making these examinations have little or no knowledge of factory conditions, job requirements, and health hazards that exist.

Selection is the first step toward the successful application of industrial medicine and the second is adequate protection. Adequate protection is provided by two means—properly designed operative, protective measures and equipment, and periodic medical examinations. Protective equipment is an engineering problem that should never be planned until the toxicologist has pointed out all the health hazards that may exist, and before he can do this he must make a careful toxicological study, which should be completed while prospective operations are in the experimental stages. By the time they have reached the semi-works, it is usually too late because the equipment for production has been selected.

In the past, many chemical engineers have assumed that because they have been able, or more frequently fortunate enough, to work through the experimental stages of a project without any visible damage to themselves, the compound at hand was non-toxic. This assumption is frequently erroneous since it is possible to have degenerative processes started in certain organs without visible or clinical evidence. For example, degenerative process in the liver may be very extensive before there is any clinical evidence. Therefore, it is a decided advantage, both from the health and economic viewpoints, to know how to start new operations with safety. There are today many operations which should be improved. Some can be made safe with reasonable changes; others will require a complete change of operating equipment.

The question may well be asked, "Why do we need periodic medical examinations if our factories are equipped with operative devices that eliminate exposure to health hazards?" My answer is: First, I have yet to see the mechanical equipment, no matter how perfect, that will continue to remain so, and very often the first knowledge of its faulty function is the appearance of toxic phenomena in the employees. Secondly, there frequently arise new sources of contamination, sometimes from within the operation and sometimes from without. Thirdly, the human flesh is heir to many ills, some developing slowly, others rapidly, many insidiously. There are many chronic ailments that are never suspected until far advanced. Many of these can be detected early and at least improved by removing the individual from any source of possible toxic irritation.

THE frequency of periodic examinations should be determined by the toxicity of the compound involved and the rapidity with which it may enter and attack the human body. Lead, for example, may produce symptoms in a few days or it may take years, depending upon the atmospheric concentrations. Benzol may cause chronic poisoning in a few days and I consider monthly examinations necessary in both lead and benzol operations. Nitro- and amino-compounds are all more or less toxic and workers in these compounds should have an examination at least every three months. Chemical plant workers who are not exposed to any known hazard should be examined once a year.

Periodic examination should be designed to bring out the physical signs and symptoms to be expected with the exposure to certain substances and need not necessarily include a general physical examination. Beta naphthylamine, alpha naphthylamine and benzidine, for example, cause tumors of the urinary bladder, and in so far as we know, do not affect other organs. Therefore, it is only essential to make a careful search for these tumors. Benzol, by its action upon the blood-forming elements, causes a primary anemia which can be detected by certain blood examinations. Thus, the entire field of periodic examinations should be based upon the clinical signs to be expected. Here again the toxicological study of a compound makes it possible to design a type of examination that will reveal to the clinician the evidence of beginning organic changes within the body.

The appearance of clinical evidence of intoxication in a well-controlled operation may mean either a failure of proper function in the equipment or a careless workman who is not following the rules of hygienic control. Faulty equipment is usually reflected in a group of employees; disobedience to rules and regulations in single individuals. In either event, the evidence indicates that employees are being poisoned, and the source of contamination should be corrected. The correction of faulty operative conditions is necessarily an engineering problem. The matter of proper handling of an individual who is showing signs of toxic absorption is entirely medical and in each individual case the physician must decide whether it is safe for the employee to continue in his operation or whether he must be removed from source of further intoxication and given special treatment.

Industrial toxicology offers the means of avoiding frequent repetition of our past experiences of human suffering, acute illness, chronic illness and death. With the aid of the toxicologist and the pathologist, we can eliminate from our industries occupational diseases and toxic processes. We can start all new operations with adequate protective measures and a scientific understanding of the toxic symptoms to expect, based upon our knowledge of the mechanism of their production.

The toxicity of a compound may vary with the conditions under which it is used. Substances which give little or no trouble at ordinary temperatures become extremely toxic at higher temperatures; some substances decompose and give off poisonous products when heated. Carbon tetrachloride brought into contact with hot metal or an open flame is oxidized and phosgene is liberated, which has a destructive action on lung tissue. In order fully to understand the toxicity of a compound, we must know how the material is handled, the temperatures to which it will be subjected, physical changes in the operation, the various conditions under which it will be handled and the possible chemical changes which may occur.

There must be a very careful study of the effect of a compound upon the body organs. What does it do? How does it do it? What organs of the body are affected and what clinical symptoms are to be expected as the result of intoxication? There are certain substances which produce disease mechanically and in themselves are not poisonous. Silica dust is an excellent example of this type of material. Fine silica dust when inhaled eventually becomes imbedded in the lung tissues, setting up an irritation which is followed by the formation of fibrous tissues. The physical characteristics of the lung change. It loses its elasticity and its function is interfered with, depending upon the stage of the disease. This is the disease known as silicosis. Silicosis is chronic, progressive, incurable, and often leads to total and permanent disability. When complicated with tuberculosis it is usually fatal.

The subject of toxicology requires the development of an extensive amount of knowledge, otherwise its application to industry is of no practical value.

Selling Management on an Industrial Health Program

PHYSICAL well-being is a prerequisite to emotional and mental well-being.* These, in turn, are essential to an alert and enlarging recognition of opportunities and responsibilities.

Recently a survey was made of some 25 industrial firms to secure information in regard to their health programs, and it is evident from this survey that the majority of employers are not yet sufficiently sold on the idea of industrial health to make a real investment in a well defined health program. It is true we have found that a great many of our larger employers have established a complete medical program and are doing a real job. However, these larger plants are in the minority, and there are vast numbers of smaller establishments, with between 10 and 1,000 employees, who have no program at all, or one which is very limited.

There seem to be three reasons for this: (1) lack of detailed information with regard to organizing such a program; (2) lack of definite knowledge of its economic value; (3) lack of some promotional agency to push the thing into action.

It is evident that our health programs must begin with the management. Some employers are still under the impression that a worker's health is his own personal problem and that the employer need not concern himself with it. Many of these employers will not fully realize the value of a worker's health until one of their key men is suddenly incapacitated and they find themselves in an awkward position. Even then, I dare say, they may lay the misfortune at the door of Providence. Years ago it was chiefly the cost of accidents that made employers realize that the accident prevention problem demanded attention, and compensation laws spurred many of them into action. I do not mean to imply that we need legislation to make us realize that health is important to industry, but it does seem that unless these problems actually cost us money in visible dollars and cents, we are very apt to disregard them.

Three special problems that the health department of an industrial plant has to consider are: (1) the physical condition of the higher executives; (2) the health hazards peculiar to industry and their effect upon the workman; (3) the study of early manifestations of disease in the workman.

Time will not permit discussion of all of these problems, but I will touch briefly on the first. Each member of the executive force should have periodically a complete physical examination. This should be just as searching and complete as that given to the workman. In any factory the higher executives control the success of the business. If these men can be kept in good physical condition, their efforts will be the more fruitful. The loss of a single executive in any department may cause considerable difficulty. The Life Extension Institute has called attention to the large number of men, at or about middle age, in whom degenerate processes of serious nature are just starting. These processes, if discovered, can usually be checked, or their progress greatly delayed, by the industrial physician. When we have sold the management on the value of physical examination for themselves and their executives, then, and then only, will we be able to sell the management on a health program.

The average cost of health work in industry is approximately $6.00 a position, per year.. There is considerable difference in this price as reported by various firms, the range being from $2.47 to $22.00 per employee per year. The plant having the $22.00 cost employed full time medical service; three nurses in the plant and one full time visiting nurse, a fully equipped industrial hospital, eye room, dental room, x-ray and physical therapy room, and required a careful physical examination of all employees with periodic health examination. This plan reported that in two years the average lost time illness had been reduced from 8 days to 3.4 days per employee, and that no days were lost from infection.

The benefits of a health program may be divided into those which affect the management and those which affect the worker. All who have written on the subject agree on the economic value of medical supervision to the management, but state difficulty of showing this in figures. Mock sums up these benefits to management as follows:

1. Reduces the time loss due to sickness and epidemics.
2. Reduces compensation for accidents, disability, deformities, and death.
3. Increases output by steadier working force.
4. Decreases hiring of new employees at a great financial saving.
5. Increases general efficiency of force.
6. Secures good will of employees.

Many employers have asked, "What size must a plant be before a health service can be established?" The number of employees is not necessarily the criterion for justification of a plant physician or nurse. Health and safety work is important in all plants, regardless of the number of employees. In referring to a recent list of small plants which provide health service, there were a number of instances of employment of part time physician and nurses where there were fewer than 500 employees. In one instance, however, there was a part time physician employed in a plant having only 167 employees; in another, a full time physician was employed where there were 310 employees.

Any plant, no matter how small the number of employees, can arrange a definite part time health program. The deciding factor is usually the interest of the management in providing protection for its workmen, the character of work done in the plant, and finally, the desirability of maintaining healthy workers. I believe you will agree that it is just as absurd for a plant having a few electric motors and elevators not to employ safety inspection as it is for the plant with a few employees to be without a health service.

The safety engineer who has made a study of accident reports can readily recall numerous cases of long-drawn-out disability caused from infected gums and teeth. The "back" case has long been the Waterloo of the claim man; any doctor will testify that prolonged disability in this class of cases is usually due to focal infection.

*ETHEL P. SCHILLING, R.N., Industrial Nurse, Domestic Coke Corporation, Fairmount, W. Va.; presented at the Annual Meeting of the National Safety Council, Louisville, Ky., October, 1935; published in *Pub. Health Nursing*, April, 1936.

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We also know that every employer has bought many hernias that did not belong to him. We have seen minor scratches fail to heal and have found that diabetes was the cause. The employer has also paid bills for many grafts where bones refused to knit and later found out that a deeply rooted disease was responsible. In short, we are charging ourselves with many disabling injuries, which would not be disabling in the first place if physical conditions had been isolated and treated before these injuries occurred.

How will your budget be drawn up for 1936? Will it be $20,000 for health or will it be $70,000 for accidents?

One-Day Absenteeism

From the Doctor's Point of View

IN ANALYZING the loss of time from illness in industry* attention is usually concentrated on conditions that cause the employee to be out for several days or weeks at a time. But every employer of labour realizes that an appreciable proportion of the absenteeism consists of absences of one day only, and it is interesting and possibly instructive, therefore, to examine more closely this one-day absenteeism.

With some individuals this assumes quite large proportions. For instance, in the factory in which I work one girl in the last six years has been out 27 times for one day at a time. She has had medical certificates on seven of these occasions, which have included the diagnoses of gastritis, swollen foot, furunculosis, fibrositis, and nervous debility. In the month of March, 2,070 girls lost a total of 874 days; 36 of these were single days. In April, out of 940 days lost, 60 were due to single days out; so that we are considering a class of absenteeism that amounts to about 5% of the whole.

Let us now consider some of the cases in detail. Many of them are just late, for in this factory to be late entails being shut out for the day. The wisdom and the possible effects of such action we will consider later. Many take the day off for some purely private affair, such as a funeral, or taking mother to hospital, and are quite honest about it: this group calls for no further comment.

But usually the people who are absent for one day bring in a doctor's certificate to explain their absence. Looking through these for the month of April, I see certificates for biliousness, depression, cystitis, gastritis, cold, menstruation, sepsis, backache, nervous debility, dental abscess, abdominal pain, sore throat, urticaria, sickness, headache, impetigo, vertigo, and pain in the face. Some of these complaints would appear serious enough to require several days, if not a week or more, out, but the girls had all recovered in one day. I have one certificate in front of me which reads: "Peggy P. is able to resume work on 17-10-34. Signed ———." The only address given is "Belvedere," and the date 16-10-34. To give industrial workers a certificate like this is equivalent to sentencing them to a storm of abuse when they arrive back at work, for it does not even say whether they were ever unable to work, let alone giving any information as to why they were not in the day before. Nor can one telephone to the doctor who signed it, and it is doubtful if the address is sufficient to find him by letter.

This queer thing, the doctor's certificate, calls for considerable attention. An enormous amount of money is collected from the panel class every year by the medical profession for these certificates. If a doctor with a panel of 1,000, for instance, signs only two certificates per year per person, it means £100 extra to him at 1s. per certificate, which is the usual charge. It is a charge on the worker which he can ill afford and I can never understand why the granting of a certificate by the panel doctor should not be included in the services for which he contracts under the Health Insurance Act. Under the present arrangement it must often be questionable how conscientiously certificates are given. It is as idle to suppose that no East End doctor with 40 patients in his waiting room will be influenced into giving 20 or so of them a certificate, when he realizes that thereby he will make £1 for nothing, as it is to suppose that every Harley Street consultant will tell the hypochondriacal wealthy duchess to get up and do a job of work, when he knows that as long as she thinks she is ill he will get two guineas or so every time he visits her. Even if the influence is not conscious, and most of us know doctors who are quite straightforward about the commercial side of their work, it is almost inevitable that subconsciously he will be affected.

Further, the practice of explaining absenteeism by the production of a doctor's certificate lends itself to easy abuse on the part of the patient.

It transpired on further investigation into the case of the girl mentioned above who had had 27 days out in six years, that she lives in a part of Canning Town which is very awkwardly situated for getting to work. She takes a tram to Plaistow Station, and then must catch the 7:15 train. If she misses this there is not another until 7:30. If she knows that her tram is likely to miss this 7:15 train, she turns round and goes home, for to go on merely means the cost of a journey to the factory and back for nothing. Obviously, if she can, she will get a doctor's certificate to explain her absence. The shilling is well spent, for this firm makes up the wages of most employees out for illness.

If a girl goes to a doctor and tells him she has been sick all night he has no alternative but to believe her, and if she asks for it she will almost certainly get a certificate for gastritis. To refuse her may mean losing a patient, and possibly damages his practice amongst her friends. It is obviously undesirable that the penalty for being late in a firm should be so severe that the employee is driven to find some excuse on health reasons. The mass of mankind are already so apt to flee from the difficulties of reality and excuse their shortcomings by an escape into illness, that any policy that is going to increase this tendency is to be deplored.

Transport difficulties are still a real problem for the workers in London, as anyone may test for himself between 7 and 8 a. m. in the more thickly populated parts of the East End, if he cares to stand near bus or tram stops, or underground stations. Free fights are common in the endeavour to win a place in bus or tram, and every year we treat in our surgery a number of injuries from this cause. Not long ago I came across a case of two sisters who failed to win a place in their bus at Canning Town, and had to wait 20 minutes for another, when five came along together. They both lost that day's pay, and had to pay extra to get home again as they could not use their workmen's tickets on the return journey. That missed seat on the bus meant to that family a loss of about 18/- in the week's income. The temptation to escape this penalty and get a trumped-up medical certificate must be enormous. The average industrial worker is rarely feeling so fit and sound that he or she hasn't an odd pain or ache somewhere that can be magnified into gastritis, enteritis, tonsilitis, or some other "itis," especially if he happens to be smarting under the sense of injustice and frustration that an incident such as the above must produce. Hence, it is clear that one important aspect of one-day absenteeism is the attitude of the firm to those who are late. What should this attitude be?

People can't come straying in when they like, but we are all tired to death of the manager who says that if one is allowed to come in late the others will all be late: such unanimity is not a feature of human life, and too rigid a discipline may hit the manager harder than he thinks in other respects. Personally, I am in favor of no penalty for being late occasionally; human beings cannot be machines, and it is very undesirable to attempt to make them so. The compulsionistic attitude of mind induced by being a slave to the god of punctuality is extremely harmful. One man in this factory is so terrified of being late that he gets here 20 minutes too early every single morning, regularly catching the same train every day. His life is so ordered that he could easily catch one of several later trains and still be on time, short of some emergency breakdown, but he dare not risk it. Asked to comment on this habit, he replied: "It's better to be half an hour early every day than two minutes late once." This over-anxious state is typical of his whole life, and is reflected in a heavy absenteeism rate for various causes. He achieves punctuality for work, but at what a cost! It would be far better for him to know that, provided he is only late once in a while, nobody would mind. Those who abuse such treatment would have to be warned, and if they still did not fall into line,

*T. O. Garland, M.B., B. Chir., D.P.H., in *The Human Factor*, January, 1936, reprinted in *Labour Management*, February, 1936. "The author is Medical Officer of a factory employing between 2,000 and 3,000 girl workers."

THE BULLETIN

of

The American Association of Industrial Physicians and Surgeons

THE object of this Association shall be to foster the study and discussion of the problems peculiar to the practice of industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes and results of the medical care of employees, and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for the mutual advancement in the practice of their profession.

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The 1936 ANNUAL MEETING of the American Association of Industrial Physicians and Surgeons will be held in Atlantic City, New Jersey, on October 5 and 6. Headquarters will be at the Traymore Hotel. This will be at the same time and place as the Annual Meeting of the National Safety Council, of which one of the Fellows of the American Association of Industrial Physicians and Surgeons, Dr. Cassius H. Watson, is President.

some severe penalty should be inflicted—dismissal if necessary. Alternately those arriving late at work 15 minutes or less might lose a quarter of an hour's time, those from 15 to 30 minutes late half an hour's time, and those more than 30 minutes late should not be allowed to start without special permission from the departmental manager. This is a system which is employed successfully in a number of big businesses today.

The same attitude is desirable to one-day absenteeism in general. There seem to be some people in the world who can go year in and year out without ever feeling ill or wanting a day off, but they are extremely rare. As for the rest of us, an occasional day away is a very healthy and tonic stimulus to greater effort when we return. Particularly is this so for girls, with their menstrual upsets, the greater strain of home problems, and their greater reaction to the emotional side of life in general. For instance, a girl, Lizzy W., I have in mind has recently had a serious illness with pleurisy and effusion. She worked in the factory for eight years with hardly any absenteeism. She got colds occasionally, and often felt a perfect wreck, she told me, but always came to work. She calls herself a nervous girl, and is very jumpy and highly strung. Lizzy often kicks and struggles in her sleep, having frequent nightmares that she is being late for work, during which she gets out of bed and starts dressing. Here it is evident that an occasional day or two off when she "felt a wreck" during those years would almost certainly have helped generally to make her life much less wearing, with the probability that she would never have had pleurisy.

Employees suffering from disabilities such as respiratory infections should be encouraged, too, to take a day off for them. The amount of droplet infection thereby saved in a crowded office or work bench would be considerable, not to mention the saving in wear and tear of other employees through contact with a person made irritable by feeling unwell.

It is of great importance for the doctor to see cases who are out for one day with medical certificates if possible. If it is impossible to see them all, then he should see all those where the diagnoses suggest some anxiety neurosis, such as nervous debility, depression, headache, neuralgia, etc., always bearing in mind that only a small proportion of medical certificates have any relation whatever to the person's real symptoms. I have actually had sent me a certificate for a man signed up as "disordered action of the heart," though he went to his doctor for a boil on his buttock. If a girl has stayed out one day and frankly admits that the only thing wrong with her is depression and that she just couldn't face work, there is always a great deal more behind this calling for investigation. Quite a serious breakdown can often be prevented by sympathetic treatment early for these cases.

Lastly, if the attitude towards the person having an occasional day out for a mild ailment is not a sympathetic one, the employee will often be driven to be more ill than he actually is in order to appear a genuine case. It is impossible to give figures or examples of this, but I have the strongest impression that it often occurs.

To sum up, my attitude is that employers probably serve their own interests best by a sympathetic attitude to one-day absenteeism; for a day off occasionally for the average worker is likely to increase his efficiency rather than decrease it, and probably often saves a more prolonged absence. Further, it is important that the penalty for being late for work should not be too severe; if it is, there may result a state of over-anxiety among the workers and a desire to explain their absence by illness. I have no very clear idea as to whether a medical certificate should be demanded or not—it depends so much on the attitude taken on these other two points.

Is the Injury an Aggravation of a Pre-existing Disease?

WHEN a condition exists which is abnormal and the doctor, either from history or an examination prior to the injury, can say this abnormal condition now present would not have existed as a result of the injury, except for the pre-existing either latent or active defect, the injury may be said to be an aggravation of a pre-existing condition.*

When a physician states that an injury is the result of an aggravation of a pre-existing disease, he is presumed to have information, gained by clinical history and physical examination, which justifies the conclusion that the condition now present would not have existed, as a result of the injury, except for the pre-existing disease.

So far as the patient's and physician's professional relationship is concerned, it is quite probable that the doctor's conclusion will not be challenged. On the other hand, if some third party is interested or if indemnity is claimed by the patient for the injury, the physician, in most instances, will be required to give a written or verbal opinion regarding the condition. Payment of the indemnity claimed may depend upon whether the injury is the result of trauma, independent of all other causes, or whether the trauma aggravated a pre-existing disease. To be able to answer this question, the physician will usually have to make an accurate analysis of all the coexisting facts of the case to satisfy himself, and be prepared to satisfy others that his deductions are correct.

Rarely will the doctor have information from examination made of the claimant before the injury occurred. In the vast majority of cases a clinical history of the patient's past health will be all he will have upon which to base his conclusions. The doctor's testimony as to history of a case, given by the patient, for whom he testifies, is usually held inadmissible in absence of evidence that the doctor obtained the history for purpose of treatment, rather than enabling him to qualify as witness for patient. To render it admissible, however, the plaintiff must establish the fact on which the exception rests; that is, the declarations were made when seeking medical aid. This rule of evidence which is usually observed may embarrass the physician when acting as a witness, if he has not treated the claimant. Obviously, if his conclusions are based upon findings made by examination previous to the injury or upon a clinical history of the claimant, secured after the injury, and the doctor is not permitted to use this information in his testimony, he may and often will, find himself without his own basis for conclusions.

In the last analysis, in cases in which indemnity is claimed, the purported facts of the patient's condition must be submitted to a legal as well as a medical review. As a general rule the law will not go farther back in the line of causation than to find the active, efficient, procuring cause of which the condition under consideration is the natural and probable consequence, in view of the existing circumstances and conditions. An injury which might naturally produce death in a person of a certain temperament or state of health is the cause of death, if the person dies by reason of it, even if he would not have died if his temperament or previous health had been different; and this is so as well when death comes through the medium of disease directly induced by the injury as when the injury interrupts the vital processes.

When there was no predisposition to disease the fact of the development of the disease after a personal injury will not be considered as an element of damages, when evidence leaves it doubtful whether development was in any way caused by the injury. The rule is: "If the latent condition itself did not cause pain, suffering, etc., but, such condition plus the accident caused such pain, suffering, etc.," the accident and not the latent condition is the proximate cause.

Patients look to their doctor for advice and help in many, many problems not technically medical, and thrice blest is the doctor who measures up to the expectations of his patients.

* Editorial, by DR. CZAR JOHNSON, Lincoln, Nebr., in *Nebraska State M. J.*, April, 1936.

Cosmetics and the Skin Game

WHEN Dr. Harvey Wiley's Pure Food and Drug Law was passed some years ago, cosmetics were a comparatively unimportant item.* Today they constitute a major industry closely affecting the health and pocketbooks of millions of consumers. Yet unless their labels bear medicinal claims for conditions recognized as disease, even poisonous cosmetics—and there are many of them—do not come within the present law. Except for a few specifically named narcotics and habit-forming drugs, precautionary labels cannot be required. The proposed statute, placed before Congress this year, retains all the valuable features of Dr. Wiley's law and brings cosmetics and curative devices of every description from obesity cures to lipsticks under government control. It prohibits all false and misleading advertising of foods, drugs and cosmetics through any medium whatever.

The term "drug" as used in the old statute has a very limited meaning. Aside from the official preparations recognized in the U. S. Pharmacopoeia and the National Formulary, the definition includes only those substances "intended to be used for the cure, mitigation or prevention of disease." Excessive weight is normal with many persons in perfect health. Preparations sold to remove normally superfluous flesh do not, by virtue of their claims to remove flesh, come within the jurisdiction of the present law. The public generally, however, regards "obesity cures" as drugs. "Marmola", according to a recent government report, may be cited as "a striking example of a dangerous flesh reducer." The preparation contains, among other ingredients, thyroid extract and bladder-wrack. Both substances tend to increase the activity of the thyroid gland and, when taken by a person whose thyroid is already over-active, their administration may cause sweating, fevers, delirium and, in unusual instances, even death. The Supreme Court of the United States in a decision adverse to the action taken by the Federal Trade Commission against this product said: "The findings supported by evidence warrant the conclusion that the preparation (Marmola) is one which cannot be used generally with safety to physical health except under medical direction and advice."

Some cosmetics defeat their purpose by robbing their users of both beauty and health. Among them hair dyes, hair tonics and depilatories stand out. . . . A hair remover containing only 2% of thallium acetate, if consistently used, may have a cumulative effect in causing bodily harm. J.A.M.A. recently reported an injury from the use of a depilatory containing this poison. This was a woman, 30 years old, who went to the Mayo Clinic in September, 1931, complaining of impaired vision. Apparently she had been well until April, 1930, except for a mild bronchitis during the three preceding months of the winter. But in April she complained of aching and general soreness of all the muscles of the body, along with some general weakness. In October other distressing symptoms appeared which kept her in bed for about two weeks. In November she suffered with aching, numbness and pain in her feet, particularly on standing or walking, and these symptoms finally involved her entire lower extremities. These troubles all resulted from the use of a depilatory containing thallium acetate, as was eventually discovered.

Lead acetate is another extremely dangerous poison sometimes found in cosmetics, more particularly in hair dyes, hair tonics, and scalp tonics. The application of preparations containing lead may cause local injury to the skin and scalp. Lead is absorbed slowly, but tends to accumulate in the system. The result may be chronic lead poisoning, with symptoms such as malnutrition, anemia, painful joints, sore gums, defective vision, abdominal tremors, and sometimes convulsions, as well as partial or complete paralysis of the limbs of the body. . . . One was found to contain essentially a salt of bismuth which was deposited on the hair shaft by a chemical action of a second fluid which appeared to be thio-sulphate. McCafferty and Hubbard, formerly of the New York Health Department, declare that the use of metallic dyes involving bismuth is dangerous. The important point in the use of these dyes is that the body tends to become saturated with the poison before the first symptoms appear.

Most women have never heard or read of a person injured by the various harmful cosmetics. There seldom is any mention in the newspapers of these cases with or without the name of the product. The reason is, of course, obvious. . . . When the story of the society matron who

* DR. CLAUDE W. CHAMBERLAIN, Asst. Superintendent of Social Hygiene, Division of Communicable Diseases, Illinois Department of Public Health; Radio Talk No. 386, March 14, 1936, over WHFC.

lost her eyesight through the use of an analine dye was given wide publicity a short time ago, a well-known company, which had not been involved in any way, were said to have been obligated to put on a $50,000 advertising campaign to keep their sales from slipping.

Since the states usually follow the lead of the Federal government, it is not surprising to find, in examining the state food and drug situation, that there is, except for the State of Maine, little or no local protection afforded consumers in the matter of cosmetics. A few states have slight regulations in one or two instances. South Dakota and New Jersey, for example, prohibit the use of methyl alcohol in any toilet preparation. Kentucky and New Hampshire prohibit the sale of hair dyes containing lead. Louisiana has no regulations on cosmetics, but cosmetics containing poisons must be so labeled, according to the State Analyst. Connecticut has no statutes covering cosmetics, but the laboratory of the State Experiment Station, like that of the New Hampshire State Board of Health, has done considerable and very skillful work in examining cosmetic preparations, hair dyes for example, and the results have been published in their annual reports. It is unfortunate that these reports can not be given more wide publicity.

The State of Maine has just passed a very excellent law requiring that formulas of all cosmetics sold in the state must be registered with the State Department of Health. This will provide a source of information to the state health officials who will be able to ban a cosmetic that constitutes a potential health hazard without waiting for someone to be killed or injured by its use. Needless to say, the cosmetic manufacturers are fighting tooth and nail to prevent the law from being put into effect. In Virginia a year or so ago a bill relating to cosmetics was introduced but failed to pass. Several years ago cosmetic legislation was introduced in the Massachusetts legislature by the Department of Public Health, but the opposition was so widespread and support so lacking, as usual in such cases, that it failed to go through.

In New Hampshire at various times many bills relating to the sale and manufacture of cosmetics have been introduced, but none up to the present time have been passed. The cosmetic manufacturers make such large profits from the sale of their commodities that they can afford to finance a powerful lobby with expensive lawyers to oppose any legislation that might in even a small measure protect consumers of their products.

Preventing Eye Injuries

THE Society* continued to act as a clearing house on industrial eye protection by cooperating with safety engineers, industrial physicians, educators, and others concerned with hazards to the eyes of workers in various occupations. The need for proper eye protection was emphasized at meetings attended by thousands of delegates during the sessions of the Greater New York Safety Conference, the First Annual Virginia State-wide Safety Conference, the All Western Safety Conference, and the Maine Safety Conference, as well as Institutes on Conservation of Vision held in Rochester, New York, Honolulu, and other places.

* From the 21st Annual Report of the National Society for the Prevention of Blindness, Inc., 50 West 50th St., New York City.

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The Eye Examination in Industry

REHABILITATION begins with prevention. Not only should examination be given before a man starts work, but periodic check-up, especially in certain occupations, should be made. The periodic check should be thorough. There is a difference between a casual and a thorough examination.*

What should constitute a thorough eye examination? How thorough such an examination should be, would, of course, depend on the job. For instance, Dr. Hart E. Fisher, of the Chicago Rapid Transit Company, examining the elevated lines' employees, makes three classifications: Class I—motormen, switchmen, signalmen, and towermen; auto truck drivers and motor bus operators; these all must have 20/20 vision without glasses in each eye, normal color perception, good fields and depth perception. Class II—conductors, regular and extra guards, etc., must have 20/20 in one eye, and 20/30 or better in the other eye, with normal color perception. Re-examination is made in both these classes every two years. Class III—station platform guards, crossing flagmen, shopmen, laborers must have combined vision of 20/30, and not less than 20/40 in one eye without glasses, and normal color perception.

Each eye should be tested separately with the Snellen chart at a distance of 20 feet with good illumination—with and without glasses. If the employee cannot see the largest letter on the chart at the 20-foot distance, he should step toward the chart until he can see it. It should be seen by the normal eye at 200 feet distant. If he has to come to within five feet before he can see it, the vision is recorded as 5/200. Usually, 20/200 is taken as industrial blindness. In some states, however, allowance is made for errors of refraction correctable with glasses. In these states I would not be industrially blind, as with my glasses I can read the 15-foot line of letters at the 20-foot distance (V.=20/15).

To continue with the examination: notations should be made of asymmetry of the face, protrusion of one or both eyes, size, shape and reactions of the pupils, colors of the eyes, movement in all directions and in convergence, the condition of the lids and the lining of the eyes, and the presence of pus or mucus in their corners. In the interior of the eyes, the optic nerve head is noted, its color, shape and irregularities, and the vessels that pass from and to it. These latter are traced outward into the periphery of the retina. This can be satisfactorily done only with the pupils enlarged. The fields of vision or side vision are tested with a target and screen or perimeter. (See case report below.) The simultaneous use of the two eyes to perceive depth should be recorded, and the percentage of fusion noted.

Naturally each employee does not need such a searching examination. Many of these tests can be made by well-trained technicians with a reasonable consumption of time, and are of value to the doctors who must judge the fitness of the candidate for the job.

The reason I spend time talking of these things is that I do not want you to be satisfied with cursory examinations or a cursory explanation of a blind eye. Let me illustrate by citing an example: Mr. A. H. (14156), a man 45 years of age, seen September 14, 1933, had been working for one of the railroads near Chicago. He was

* Excerpt of the paper by THOMAS D. ALLEN, M.D., "Rehabilitation After Injury to an Employee's Only Good Eye," presented at the National Safety Council Annual Congress, Louisville, October, 1935, and printed in *Sight-Saving Review*, December, 1935.

struck in the back of the head while hanging on to a car and waving a lantern, about June, 1932. He was knocked off the car and rendered unconscious, and by accident found a few minutes later by the head light of an engine. He was examined three weeks later, and the central vision found normal in each eye. No fields of vision were taken. There was no evidence of syphilis, but the reflexes were slightly sluggish. Some eight or 10 years before the Wassermann test had been reported negative. Three months after the accident, he got a cinder in the left eye, and found he could not see well with the right eye, since which time the right vision had become progressively worse. Twice during his first interview with me he strenuously denied ever having seen double, but later admitted that he had been seeing double for about six weeks. He denied infection, and all subjective and objective symptoms of syphilis. He used tobacco in moderation, smoking about one package of cigarettes a day.

His vision in the right eye was only hand movements at one foot. In the left eye, his central vision was normal, but his fields were contracted to 70 degrees temporally, 40 degrees above, 50 degrees nasally, 50 degrees below, and colors within the five degree circle.

He had all the physical signs of tabes, a syphilitic infection of the brain and spinal cord.

I saw him again about six months later, at which time he could see light only in certain fields with the right eye, and count fingers at one foot in certain fields with the left eye.

In this particular instance it would have been very wise for the doctors to have taken the fields of vision and the muscle balance at regular intervals, before he was injured. Repeated Wassermann tests might also have been a safeguard, although one must not rely 100% on the reports of the Wassermann test.

Thirty-five hundred dollars were paid by the company in compensation; $500 in doctor bills. This money could better have been spent in making thorough examinations at frequent intervals; it would have paid for a complete medical policy for the entire company for an entire year, and it would probably have saved the man's sight and his mind. As it is, the man and his dependents will be state charges for many years.

Many of the routine tests included in a survey can be made by well-trained technicians who have not had medical training. Surveys of employees cannot be properly evaluated by non-medical men for the simple reason that their education has been inadequate. Where it is desired to have a survey, and a qualified medical man is not available, one should get the next best, recognizing, of course, his limitations.

Recently I heard about an employee who got soap in one eye, and found he could not see with the other. The history was that, as a result of a slight blast of air from an air hose, the retina had become detached. After several operations the eye was removed. A report was never made of the contents of the eye. Two years later the man died of a brain tumor, the characteristics of which resembled very closely a tumor of the eye. In the meantime, the man had been paid for the loss of one eye. The point is this: there was undoubtedly a tumor (cancerous growth) in the eye causing the detachment of the retina which proper medical examination should have revealed. Had that eye been removed early and examined for cancer, suitable treatment could have been instituted at once and the man's life saved. The cheapest treatment of human ailments is careful management by the best doctors.

Glaucoma is a disease which is much more frequent in late life, particularly in those who are worried from one cause or another, or in those who have a family history of glaucoma. It is a disease which may creep on a person without any warning, and so rob him of sight that one eye becomes industrially blind before he is aware of the fact. It seems to seek out the most valuable employees. Study of the fields of vision is of great importance in diagnosing this disease. Such safety measures reduce the need for rehabilitation.

Many other diseases, such as syphilis, retinitis pigmentosa, Bright's disease, diseases of the white cells and the red cells in the blood, blood vessel and heart diseases, etc., can rob a person of the use of one eye without the employee or employer being conscious of the fact. These employees are potential dangers, and great precautions should be taken with their remaining sight. Thorough physical examinations at frequent intervals will reduce accidents to the minimum. As a result of such examinations, employees may be better placed where they will not harm themselves or others. Early treatment affords the best chance of avoiding blindness and the resultant need for rehabilitation.

First Aid in Eye Injuries

INASMUCH as the most efficient first aid is prophylaxis, with your indulgence we will not limit our discussion wholly to treatment of injuries already sustained.*

Some 16 months ago several of us Chicago Eye Physicians cooperated to produce an exhibit for the A. M. A. Convention on this same subject. Some of the same features were used this past summer in a second exhibit. It is the ideas of these exhibits that I wish to bring before you. Dr. Glen. Nethercut is cooperating with me at this time by bringing to your attention the essential features of these exhibits.

The subject is most easily handled by dividing it into age groups.

In the first place malformations and prenatal disease can be reduced to a minimum by careful check of both mother and father before conception. If both are healthy, and if the mother remains healthy during pregnancy, there will be little chance of congenital or prenatal disease or injury.

During delivery, accidents happen to eyes. Forceps, fingers and pus are the main offenders. If the delivery is preceded by thorough cleansing little need we fear pus. Still, if silver nitrate is used â la Credé no harm results and there is established a habit which has been known to save many eyes. Credé's treatment may cause a swelling and discharge for a day or two, but this is seldom severe, and almost never lasts over two days.

Forceps can press upon an eye and cause slight or severe injury, from a small subconjunctival hemorrhage to rupture of the eyeball. The finger or gauze may be drawn across the face in such a way as to open the lids and even scrape the cornea. Thorough cleansing with the mildest of antiseptics such as half saturated boric acid solution, repeated as necessary but not too frequently, is probably the most satisfactory treatment. It must be remembered that the eye, especially that of an infant, is a most delicate structure, and it should be handled with proper regard. Ordinarily it is not necessary to use large instruments to evert the lids or reach every cranny of the conjunctival sac. Instrumentation is harmful, and unless it is definitely indicated, it is inadvisable.

When trauma to the eye has occurred, thorough examination is indicated. To view the palpebral conjunctiva one need only pull the lids apart with the two thumbs. Should the skin be slippery a bit of gauze over the thumbs suffices. A simple manipulation of the thumb on the lower lid, pressing slightly on the eyeball will push the eyeball back into the orbit and the conjunctival fornices will be pushed outward into view and can be treated with an albuminate of silver or boric irrigation (a soft tipped rubber ear syringe is ideal for this).

The cornea in both these manipulations will be covered. In order to expose it, it is necessary to start again. We use a small Desmarre's lid retractor for the upper lid and the thumb on the lower lid. Under these conditions 1% or 2% sol. of potassium fluorescein may be instilled and washed out, to demonstrate defects in the corneal epithelium.

Of course, in all these manipulations the hands and all instruments touching the eye must be aseptic, as post partum infection may occur. The mother must be instructed in this technique.

Should conjunctivitis occur, a smear and a culture should be taken at once, and if positive for Neisserian, the case should be taken to a hospital where special attention is given to the treatment, e.g. Cook County Hospital. This treatment does not properly fall into our discussion, as it is not strictly first aid. If the infection is not Neisserian. mild antiseptics are best unless corneal complications occur. Consultation is always in order.

When the child begins to creep there should be a special pen for him with a special floor free from the dust and dirt from the shoes of older children and adults, until the baby can be taught not to get his fingers into his eyes, But it is remarkable without these contrivances how little infection takes place, This is due to the anatomical arrangement of the lids and the character and course of the tears, Should sand or other foreign body get into the eye, pull the upper lid over the lower; this may dislodge the foreign body or start the tears which may wash it

* Dr. Thomas D. Allen, at Chicago Medical Society Symposium on Iritis, October 30, 1935; *Illinois M. J.*, March, 1936.

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out. This failing, irrigate with boric acid. The trick lies in holding the child properly. His head should be steadied between the doctor's knees, and the body of the child should be on the nurse's or mother's lap, the legs held by the nurse's elbows and arms, and the hands by the nurse's hands.

Of course sharp toys (scissors, ice picks, knives, needles, pins, darts, etc.) will not purposely be left in the child's path. But if the eye is injured, it may be washed only with sterile boric acid solution. Should this not be available do not substitute. Merely apply a clean bandage and call an eye physician. Too little attention is better than too much. Should an eye physician not be available, the eye should be handled by a surgeon under the most aseptic conditions.

Recently I have seen several examples of that most heart-rending accident prevalent among school children: a bent pin, or a bit of broken copper wire penetrating the cornea. These had been shot by rubber bands; in each case, the cornea and lens were penetrated, cataract naturally resulting. Infection often follows. First aid treatment consists in removing the foreign body, applying a mild antiseptic ointment, such as 1:3000 bichloride of mercury, between the lids and covering the eye with a light aseptic dressing. The subsequent care of such a case is often prolonged and complicated; again consultation is in order.

In adults foreign bodies may require first aid treatment. If a cinder lodges under the upper lid, it is usually easily removed with a sterile applicator moistened with boric acid. Have the patient open both eyes, look down, and refrain from raising his eyebrows. Take the eyelashes of the upper lid with thumb and first finger, pull the lid away from the eye, press gently with a pencil or the reverse end of the applicator on the center of the upper lid, and simultaneously lift the eyelashes and press them gently against the eye. A cinder on the cornea is not so easily removed. The eye must be anesthetized. Pantocaine 0.5% to 1% is the most popular anesthetic at present. Two drops at an interval of two minutes will usually be sufficient to allow the application of a spud. A spotlight is necessary. The technique should be acquired by personal instruction from a competent man.

Automobile accidents are increasing, and although safety glass is now fairly standard we do have many eyelids torn. These should be accurately repaired at once if the eye itself is not badly damaged, or if an eye physician is not available within a few hours. Otherwise a boric acid dressing is proper.

Should there be a penetrating wound, an x-ray should always be made. Even glass may cast a shadow (if it has enough lead in it). Dr. Wilder always made it a practice to fasten a spicule of the glass suspected of being in the eye, to the side of the nose or cheek, when having the x-ray taken, to demonstrate the opaqueness of the glass.

Goggles have greatly interfered with surgical ophthalmology. But even yet we must use the magnet on occasions. to remove magnetic foreign bodies from eyes. The sooner this is done the better; until this is done, the first aid treatment is atropine and bandage.

For burns of the eye, one should immediately dilute with quantities of tap water preferably from the hot tap (as water that has passed through a boiler is more sterile than otherwise). If the burn is from an acid and a mild alkaline eyewash can be obtained within 30 seconds, use it. Not long ago I saw a technician who splashed one drop of tenth normal sodium hydrate into her eye. She immediately washed it out with an ounce of tenth normal hydrochloric acid. The result was an unnecessary and severe acid burn.

Pieces of mortar or slacked lime occasionally get under the lids. Immediate treatment is rapid dilution with tap water, and this can be more thoroughly done if the eye is anesthetized with cocaine or one of its substitutes. The lids should be everted, indeed doubly everted. This can easily be done with a Desmarre's retractor or a Walker's lid everter (Beard's Ophthalmic Surgery, p. 373). All particles must be removed before one can say it is thoroughly done.

The use of tear gas is increasing, consequently we must be prepared to care for such cases. Dr. Wm. D. McNally recommends, after considerable experience, first—large quantities of tap water, followed by 0.4% sod. sulphite, in glycerine 75% and water 25%. This should be used immediately and frequently in the eyes, and if severe burns have occurred the fornices must be probed to keep adhesions from forming between the lids and eyeball. On the face 4% sod. sulphite in 50% alcohol is more efficacious.

For refrigerating gas (SO_2) burns, sod. bicarb. 0.4% in glycerine 75% and water 25% is found efficacious. It also should be preceded by thorough irrigation with quantities of water.

In the city, corneal ulcers seldom require the attention of the general practitioner. The handling of such cases is not always easy for the specialist, and inasmuch as so many specialists are available, it is never necessary for a general practitioner to assume the responsibility of such a case.

The doctor who is called to give first aid is in a psychological position to inquire the cause of the injury and suggest prophylactic measures against repetition. Many protective devices in industry today are the result of careful study of accidents by inquiring and thoughtful physicians.

Preliminary Management of the Seriously Injured

DR. EVE summarizes procedures in the preliminary management of seriously injured as follows:*

1. All head injuries should be looked upon as serious.

2. The first care is to treat the shock and never operate upon or ex-

* DUNCAN EVE, JR., M.D., in *J. Tennessee M.A.*, XXVIII, pp. 445-449, November, 1935.

amine more than absolutely necessary, except to control hemorrhage.

3. Should not distinguish between fractures of the base of the skull and fractures of the vault. The guide for treatment is based on the intracranial injury.

4. During shock, do not attempt to dehydrate the patient, and it is not necessary to rush a patient to the x-ray room. These should be postponed until a more suitable time.

5. All patients should be kept in bed for a long period and kept from active work for several months.

Very frequently head injuries are associated with other injuries. Fractures of the upper extremities and the lower extremities can be immobilized by a Thomas splint. Therefore, traction can be applied to both extremities. Many fractures with head injuries can be reduced by local anesthesia. With spine and pelvic fractures, the patient can be placed on a Bradford frame or can use a fracture board under the mattress; therefore, all fractures can be treated temporarily, or until the primary shock has passed. Open wounds of the soft parts associated with head injury can be taken care of by applying a sterile compress for 24 hours and then can be repaired. However, all face wounds should be repaired as early as possible.

If the patient is in a considerable degree of shock, he should be left undisturbed until some reaction is noticed, and until there is a rise of blood pressure.

Spine: Injuries to the spine should be examined, if possible, at site of the accident before they are moved, to see if the spinal cord is involved. Remember 80% of spine fractures (compression) occur between the tenth dorsal and the third lumbar. The diagnosis is made on the history and localized pain and tenderness. In case the patient is in severe pain and cannot raise himself, he should then be transported with extreme care. He should be placed on his abdomen, and in lifting the patient his spine should not be flexed. If possible, a pillow or some object should be placed under the patient's chest, so as to prevent flexion of the spine. After arriving in the hospital, if there is any degree of shock, it should be treated before the x-ray is made. Complete reductions of fresh compression fractures are possible when proper hyperextension and fixation are applied early.

Pelvic Fractures: These are frequent injuries, and the displacement depends upon the amount of force. The diagnosis usually can be made by presence of localized pain and tenderness. Fractures of the pelvis are often serious injuries and are associated with shock, and should be transported with great care. In a fair percentage of pelvic fractures the urethra or bladder is injured; therefore, always make a rectal examination to see whether any sharp spicules of bone protrude toward the rectum. The urethra should be carefully examined for blood. A soft rubber catheter should be used in obtaining a specimen of urine. In case of free blood, the catheter should be left in place. Occasionally when the urethra is torn and the urine cannot be passed through the track, a suprapubic cystotomy should be performed. To establish a dianosis in detail will require the x-ray. The overhead pelvic suspension frame with traction on limbs and a fracture board give the best results.

Amputations: The danger in amputation is shock and hemorrhage. In all extensive wounds (crushed) that require amputation, the tourniquet should be applied immediately around the arm or thigh and never around the forearm or leg. Remove only the clothes in the neighborhood of the wound, and apply a large sterile gauze compress and maintain by a firmed bandage. If the crushed condition involves the forearm or leg, then immobilize with a splint at the elbow or knee joint. Morphine is given, and the patient can be transported. After arriving in the hospital, treatment of shock should be instituted. The shock resulting from major amputation is due mainly to the division of large nerve trunks close to the body. Shall amputation be performed at once, or shall it be delayed for several hours? Many surgeons still postpone the operation several hours; however, the writer prefers to operate in a short period after arriving in the hospital, due to the fact that in many cases the extremities are attached by a few shreds of tissue. In many cases it is impossible to secure proper compress of the vessels, the tourniquet being on too long, and there is risk of hemorrhage. All cases should be given the A.T.S., and those with extremities that are extensively mangled or crushed and especially those coming from a long distance should be given the gas-bacillus serum.

Gun Shot Wounds: The management consists of early application of sterile dressing and noninterference with the wound, except to arrest the hemorrhage. Early immobilization in case of fracture. Early administration of A.T.S and treatment of shock. After reaction of shock, if possible, get a complete, detailed history of the accident and get the patient to a hospital for final diagnosis and treatment, especially if it is an abdominal wound.

Traumatic Injuries of the Abdomen: The main symptoms are pain, either local or general, abdominal rigidity, and dullness in the flanks. Usually such injuries are associated with shock; however, occasionally shock is not present, especially if an opiate has been given. The majority of patients will request a delay of the operation; however, a delay beyond eight to 10 hours will probably result in peritonitis and death to the patient. In all traumatic conditions of the abdomen, it is better to hospitalize, and carefully observe the patient.

Extensive Burns: The extent of the burned area is of more importance than the depth. The conditions to combat are shock and toxemia. Shock is due to pain, loss of body heat, and loss of body fluids. The management of burns may be briefly described as follows: Immediately give a large dose of morphine to relieve the intense pain. All burned area is then covered with dry sterile gauze and maintained by a gauze bandage. This dressing is then soaked with fresh 2.5% acqueous solution of tannic acid. The dressings do not have to be inspected for 16 to 24 hours, or until the parts become a light brown in color, when all dressings can be removed. However, it is best to wet the dressings again with tannic acid solution a short time before the removal. The wound is now left exposed to the air under a cradle, with or without artificial heat, depending upon the area and extent of the burn. All patients should have force fluids 4,000 to 8,000 c.c. per 24 hours, and with very extensive burns, blood transfusion. The preliminary treatment of burns with tannic acid compresses followed by exposure to air lessens toxemia.

Shock: Surgical shock has been described by Fraser as a state of depression of all the body functions, primarily induced by injury and characterized by a progressive fall in the blood pressure. The patient responds clearly; the skin is cold and clammy with beads of perspiration on the face; the muscles are relaxed; the pulse is rapid; the respiration is shallow and irregular; and marked thirst and insensibility to pain completes the picture. In such injuries as have been discussed in this paper, we are concerned with secondary shock which appears an hour or more after the injury. Primary shock is still unexplained, but its rapid onset within the first hour after trauma indicates that it is of nervous origin. The active treatment of surgical shock should include heat, morphine to control pain, rest, and the replacement of lost blood volume by intravenous fluids, the best of which is blood or plasma. Neither normal nor hypertonic saline solutions are retained in the vessels and further deplete the proteins; however, good results have been reported from intravenous injection of 2,000 to 8,000 c.c. of normal saline at the rate of 500 c.c. every 15 minutes. Vasoconstrictor drugs as adrenalin and pituitrin are not indicated in secondary shock as the adreno-sympathetic system is already markedly stimulated. Ephedrine causes dilation of the intestinal and limb vessels and increases the rate of cardiac contractions, and good results have been reported of its use; however, at times it depresses the heart. Digitalis may be of some value if the heart was diseased prior to the onset of shock. Therefore, we might say that stimulants are of little value. Elevation of the foot of the bed and bandaging of the extremities will aid in the return of blood to the heart.

Traumatic Hernia

HERNIAS play an important role in the lives of all people, and present many and varied problems in their social, economic, industrial and medical activities.* We will not consider all phases of the matter, nor in fact all forms of hernia, but more particularly what in modern industrial and legal usage has become known as traumatic hernia.

To us the term is a misnomer. To us the laity and jurists have a wrong concept of the matter, and to judge

*R. O. Simmons, M.D., and King Rand, M.D., in *New Orleans M. & S. J.*, April, 1936; from their paper read before the Louisiana State Med. Soc., New Orleans, April 29-May 1, 1935.

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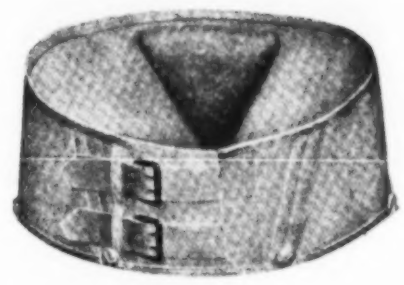

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from the type of testimony of competent medical experts to whom we have listened while they were under the spell of the solemn oath, a short consideration of the problem is not amiss.

A hernia may be defined as an abnormal protrusion of a viscus in whole or in part through its retaining cavity wall. We restrict our comments to abdominal hernias and our arguments more especially to the types most frequently encountered both in clinic and in court, i.e., inguinal hernia. Before we can in equity settle the matter of liability of industry to workmen disabled through hernia, let us consider how hernias develop, with the theories and facts of their origin.

There is abundant evidence that most, if not all, hernias are congenital. There is embryological evidence that this is true in a great percentage of cases, enough to lay the proper foundation for our argument, as will be presently shown, and the evidence of an heredity factor is strong enough to behoove one to choose a healthy grandfather if he is to remain whole himself. Draper and associates, in studying the history of 20 males afflicted with hernia, found 14, or 46.66%, of their fathers had hernias.[1] Morrison relates the case history of a hernia patient whose father and paternal uncle had hernias; of his own seven brothers and sisters, four had inguinal hernias; among his four children two had hernias; and of his own sister with an inguinal hernia, who married a similarly affected gentleman, the fruits of their union were four children all of whom had hernia.[2] Birkenfeld, writing in a German periodical, concludes after a study of the family history in numerous cases that heredity plays a dominant role in the etiology of hernia; in fact, in producing a specific kind of hernia, and variability of kind, or inherited tendencies. Thus one family had all inguinal hernias, one family all umbilical hernia, and another all varieties. He further observes that in persons with hernia manifested as stigmata of degeneration, as shown in the family history, after operations have recurrences of 11%, as against a 4 % without such a family tendency.[3] We, who practice in the South, have frequently observed that there is a racial weakness for umbilical hernia in the negro race, it being absent much more commonly in the white race. Bernstein[4] relates after a study of the problem that he found a decided tendency to hernia in fetuses, drawing his conclusions from autopsy studies. It is stated that the instance of hernia[5] is as one is to 14.9 in males, and in females as one is to 44.7. With a rate determined from a study of the reports of insurance examinations, it is found that there is an incidence in males of 7.2.[6] Further testimony giving strong support to congenital theory is that a large percentage of hernias are recognized in the first years of life. Grazer[5] quotes Berger who reports 6,220 cases of inguinal hernia—4.526 were bilateral; a common experience in all of our practice is for an inguinal hernia to develop on the opposite side, following a single hernioplasty. Where congenital hernia cannot be diagnosed at birth or early in childhood, the sac itself is congenital. This results, in numerous instances, from insufficient obliteration of the vaginal process. There is then provided a pouch more or less conical in shape, subjected to the numerous strains of increased abdominal pressure, incident to coughing, sneezing, defecation and muscular action. Ultimately, as the tense membrane before the presenting head thins and dilates the cervix, it stretches the already laxed tissues and gradually there develops a hernia, noticed most likely in later years by the working person during muscular strain, and the stage is set for a so-called traumatic hernia. It is indeed a strange and remarkable coincidence that patients seen in private practice who present an inguinal hernia can seldom tell the time and place when first noticed, and if so, they seldom attribute the hernia to a specific force, that is, trauma. It just happens.

Hughson[7] reports that in a series of cases in which a relaxed ring was opened, in which no clinical evidence of hernia was noted, a small persistent sac was found, concluding that a correlation of these findings gave further support to the performed sac theory in regard to the etiology of hernia. He further states that 16% of patients with hernia on one side eventually develop hernia on the opposite side. We believe recorded medical evidence is in harmony with the belief, and in private discussion with surgical friends, they agree that most hernias result primarily from a congenital weakness or defect, and that most of them are slow in development. But, as one of our legal friends remarked, the courts are not to be too harshly criticized for the almost absurd position they have taken with reference to accidental hernias, for the fault, if any, lies in the medical profession upon whom, in all such cases, the courts are necessarily compelled to rely. The judges are only laymen where medical questions are involved and so long as doctors may be found who will give positive and emphatic testimony that a hernia is practically always caused by an accident, and is always disabling, industry will be compelled unjustly to compensate many employees who can easily prove that they acquired a hernia during the time they were employed.

At a national meeting of the Conference Board of Physicians in Industry[7], a member reported a case of traumatic hernia. In the opinion of all the other members in attendance, no case of traumatic hernia had ever been known to them. It was their opinion that a true traumatic hernia is indeed rare, and of negligible importance, and that the development of inguinal hernia should be considered an occupational disease and compensation should be paid on the basis of aggravation of a pre-existing condition, rather than as the result of a definite injury.

I believe that I have presented sufficient evidence to show that hernia is a common condition in the male of all ages from fetal life to old age; that heredity is a common factor in its production; that trauma per se is a negligible factor of such minor importance as to merit slight consideration; that in individuals coming within the scope of protection of the state workmen's compensation act, muscular activity associated with labor is readily proved in court as an etiological factor, a condition given small credit in the history of those not so favored. We believe that most hernias should be considered as an occupational disease of gradual development, and should be so recognized in law as in medicine, and that such conditions should be compensated for only as an aggravation of a pre-existing condition. We all know that most hernias are correctible surgically, with only about 5% failures[9], and that the operation is very seldom attended

with death in the absence of concomitant complications. Our position is not revolutionary or untried. Kessler[9] compiled, from a study of the situation in foreign countries, many of which have progressed further than we have along the road of social reform, a schedule of variable values for hernia as follows: The French jurisprudence, 10% to 33% total; the German jurisprudence, 10% to 50% total; Swedish legislation 15% total; Italian legislation, 10% total; Swiss laws, 15% total and Austrian imperial office, 69% total.

It is noted that the larger percentages above represent estimates of disability in the presence of severe complications.

In conclusion, it is a recognized fact of common medical knowledge that untold thousands of men carry hernias throughout life, earning their living by the sweat of their brows. You have seen them, so have I. Such men are being subjected to an injustice, for industry today to protect its own interest is insisting on preliminary physical examination as a requisite to employment, and a workman is not allowed on the job who is cursed with a hernia of any degree or who has a lax or larger ring than normal which constitutes a potential hernia. Such men are capable of doing many kinds of work and but for the present ridiculous attitude of the law and courts towards the question, such men might remain useful, self-sustaining citizens, maintaining their own self respect. The whole question deserves earnest consideration by members of the profession and honest conclusions after their deliberations.

Discussion:

DR. LUCIAN H. LANDRY (New Orleans): Dr. Rand has given us a very good topic to think about, but I have no suggestion to make that will assist in clearing up the question. We know that the so-called traumatic hernia is a very bad term; the insurance companies introduced it when the compensation law was first put into effect and it was meant to describe a type of hernia which is rarely seen, if at all, and practically amounts to an evisceration. If intra-abdominal pressure cna be classed as trauma, then all herniae are traumatic, but if trauma is interpreted as external violence, then traumatic hernia is indeed a rarity.

It has been my experience that most insurance companies are willing to pay the hospital and the doctor for a hernia that develops while the man is on the job and consults the doctor within a reasonable time after the occurrence. It has also been my experience that the greater percentage of these herniae show a well formed peritoneal pouch or sac, many of them continuous with the tunica which anatomically are classed as congenital hernia.

DR. J. C. MENENDEZ (New Orleans): The question of traumatic hernia is one of the most serious problems that men in industrial surgery are presented with today. I believe, and I agree that many of the men who are conversant with this particular subject believe, that the condition of traumatic hernia is a rare thing. They go further, and I agree with them there also, in saying a traumatic inguinal hernia, especially of the indirect type, is an impossibility. Of course you can readily understand that with direct violence to the abdominal wall, whether the inner region or the lower or upper region. there is a possibility of a traumatic hernia, or, so to speak, a definite tearing away of the structures of the abdominal wall. I have had occasion to see only one such case which occurred several years ago in the city of New Orleans. There was a direct blow to the lower abdomen, the right quadrant, in which there was no tearing of the skin, but there was a separating of muscles, and tearing of the fascia, and the peritoneum. In this case there was extreme shock. As a matter of fact, it required hours of treatment for shock before we thought the patient would survive the particular injury.

William F. Schaeffer, of New Jersey, brought out a very wonderful article describing fully his ideas and interpretation of hernia formations.* He and others believed that the traumatic inguinal hernia, direct or indirect, does not exist, especially of the indirect type.

The question which is also of importance from a medicolegal aspect today is the question of so-called occupational hernia. I do not think, and I believe it is the consensus of opinion of men practicing medicine today, especially in the industrial field, that the burden of responsibility for hernias should lie upon the indemnifying companies. I have been preaching this for a long time on account of my interest in this matter, of my research study of the literature, investigations, and so forth, and naturally I have taken that particular stand for a long time. Today conditions are somewhat different in my employment and practice and the type of work I do, and I still adhere to that feeling, that hernias are not only and solely contributable to occupation. Therefore, it is a question to me whether or not we would consider it an occupational disease. Why should we place the burden of proof and responsibility upon industry, when it might be caused by an effort which increases intra-abdominal pressure, whether, as Dr. Rand brought out very nicely, due to the evacuation of the bowel, coughing (the greatest offending condition I know of), or any effort whatsoever in the home, such as getting in and out of the bath tub, and so forth? Why should the burden be placed upon the insurance company? Considering the congenital predisposition, about 25% of the effort may be attributed to occupation or industry, and the balance to everyday physiological and pathological effort, not to speak of what causes the increase in intra-abdominal pressure. To me it is somewhat misleading to have industry feel that it is responsible for hernia development—especially from an occupational disease standpoint.

Of course there is no sense in my going into the medicolegal aspect, for that should be taken up by a legal mind.

A question well brought out by Dr. Rand was the question of the physical examination as a prerequisite to employment which will rule out, to a great extent, hernias that are classified as traumatic or occupational.

DR. KING RAND (Alexandria): The remarks of the two gentlemen are perfectly in line with the information that you can glean from all medical literature, which varies from that found in the court room. I think the term is a misnomer, but in dealing with the field for many years, I have had the misfortune of seeing much of what I might call traumatic hernia.

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*In *J. M. Soc., New Jersey*, February, 1930.

Traumatic Shock

PREVENTION is the best treatment for shock.* Fractures of the long bones and the head injuries probably offer the largest field for educational work in the prevention of shock. It is estimated that there are a million fractures in the United States annually, one-third of which are in the long bones. Every patient having a severe fracture is potentially or actually in shock. The American College of Surgeons is doing educational work in the care and treatment of fractures. A survey shows that at least 50% of our ambulances are operated by the morticians, and that only 15% are equipped with splints. During the late war the English reduced the mortality 50% in fracture cases by adopting the use of the Thomas splint. We, as doctors, should attempt to educate the public, the ambulances drivers, policemen, etc., that they should not try to move a man with a broken leg or arm without first applying a splint, preferably a Thomas splint, which gives fixation and traction, and the patient should be kept warm while in transit to the hospital. The Red Cross and Boy Scouts are being taught the proper first aid treatment in cases of this type. Someone has

* PERKINS, PERCY A., M.D., in *J. Tennessee M.A.*, XXVIII; 461-463, November, 1935.

advised that not only ambulances be equipped to handle these emergencies, but that filling stations on the highways should include first aid equipment and splints as part of their service.

Next in importance is the care of head injuries. See that these patients are put to bed, made comfortable, and kept warm. Do not permit them to be disturbed by having x-ray examinations on admittance to the hospital. That can wait. It is the injury to the brain, and not the fracture, that counts. Admittedly, it makes a big hit in a lawsuit to be able to show to the jury a crack in the skull. After all, the conservative treatment of head injuries is best. The mortality in one of the large hospitals has been reduced from 52.1% to 21.7% by the conservative method of treatment.

Do not operate on a patient while he is in shock. Wait for reaction. Some state that if the blood pressure is below 90 it is very unwise to operate. In certain types of injuries, however, such as a fractured pelvis with injury to bladder or urethra, or concealed hemorrhage, when operation is imperative, it has been my custom to precede the operation by infusion of glucose 10% and adrenalin while the blood is being typed and then by blood transfusion. The anesthetic of choice is gas and oxygen with local anesthesia.

The routine treatment is keeping the patient warm by use of hot-water bottles and blankets, giving morphine for relief of pain and for relaxation (the exception being head injuries), elevation of the foot of the bed, and often bandaging of the lower extremities. Increase the volume by infusions or transfusions. The increase in volume inhibits the adrenal secretion. Dr. Coller says that about 1,000 c.c. of fluid are lost during an operation and the first four hours after and that the basic fluid requirement daily is about 3,000 c.c., so in order to keep the proper fluid or water balance, the patient must get at least 3,000 c.c. daily. The fear of embarrassing the heart by giving saline or glucose infusions is unfounded. Infusions given at the rate of 1,000 c.c. in 30 minutes mean only six minims passing through the ventricle at each systole. The normal heart muscle has been proved very resilient, and increasing the volume seems to improve its tone. Some advocate salines and glucose intravenously by continuous drip method, but others say there is danger of damaging the vessel walls and producing an embolus. The crystalloid solutions of sodium chloride and glucose shorten the coagulation time. The slight increase in blood pressure by the use of glucose and saline does not increase bleeding. Nature is the perfect machinery, and is able to stabilize itself especially as to blood pressure and dilutions. There is probably very little nutritive value to the glucose; however, in shock this is of little importance, as in shock the blood sugar is normal or slightly elevated. Saline and glucose solutions are retained only a short time in the blood vessels, less than an hour. Six per cent gum acacia in nine-tenths per cent saline solution is retained longer than saline on account of colloidal properties, and has osmotic powers that enable it to attract fluids from the tissue. The blood transfusion, in my experience, is best of all. Not only does this increase the volume and oxygen content, but the protein content of the plasma enhances the osmotic process. Watch your patient, and take frequent blood pressure readings, and do not postpone treatment too long. A blood pressure of 80 or less for more than an hour does irreparable damage, especially to cortical nerve cells, and the patient will eventually succumb. Drug medication is valuable in primary shock, but of less value in secondary shock, as in the latter we need volume instead of increased blood pressure. Caffein, epinephrine, cortin, and ephedrine are the most commonly used. Cortin, or eschatin (the cortical hormone), is proving much

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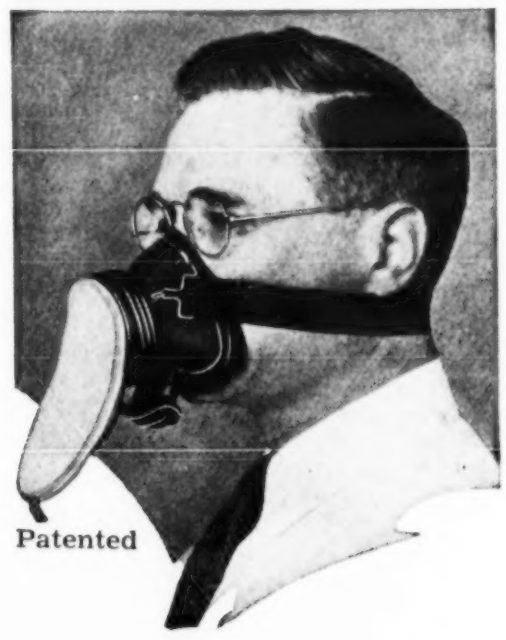

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more effective than epinephrine (adrenal hydrochloride). The action of ephedrine is more prolonged than epinephrine, but is uncertain and tricky, and will often produce the opposite effect from that desired. Its use in combating the low pressure accompanying spinal anesthesia has been discontinued by some surgeons.

Surgical Management of Severe Head Injuries

ONLY about 6% of severe head injuries should be subjected to surgical interference.[1]

Depressed fractures of the skull should be elevated because of the danger of secondary complications.

One should not rely upon the classical syndrome in hemorrhage from the middle meningeal artery, but should be on guard for other signs.

Subtemporal decompressions purely as a means of relieving increased intracranial pressure should be discarded.

Strangulation of Pre-existing Hernia Attributed to Strain

THE employee had suffered from an irreducible hernia for several years, but had worked regularly and had experienced little trouble from his condition. He was employed as a craneman, and during the process of repairing a broken crane he "strained or twisted" himself, a strangulated hernia developed, and he died 11 days later. His widow instituted proceedings under the workman's compensation act of Maryland. The Industrial Accident Commission denied compensation and, from a judgment of the circuit court reversing the order of the Commission, the employer and its insurance carrier appealed to the Court of Appeals of Maryland.[2]

The main controversy involved whether the injury was accidental within the meaning of the workmen's compensation act. A twist of a part of the human body, said the court, while engaged in the performance of some physical labor implies a sudden, unforeseen and unnatural bodily position or movement or muscular distortion that generally occurs without anticipation. The twist that was inflicted on the employee in the course of his work was not a natural result that could be assumed to have been intended or expected. It was produced by a sudden, unintended movement of a heavy chain he was holding, which caused the affected parts of his body to be forced or thrown from a normal state into a hurried, unexpected and unnatural or distorted position. If the lifting and holding of a heavy chain under difficult, insecure and unusual conditions should cause a rupture, the injury would, in ordinary acceptation, be described as an accident. The conclusion that the strangulated hernia was the result of an accidental injury, said the court, is supported by a number of decisions. The old hernia with which the employee was suffering for some years before the accident was not the hernia for which compensation was claimed. The compensable injury was a strangulated hernia, which did not exist before the accident but which was directly caused by the accident. This strangulated hernia caused the employee's death, and, where death ensues, there is no basis for the determination of the proportionate disability attributable to an old hernia and to the later strangulated hernia. The court, therefore, affirmed the judgment for the claimant.

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Management of Brain Injuries

THE surgeon who undertakes the management of brain injury cases should have a thorough understanding of the pathological physiology involved, and its relation to the variations in the clinical picture of the patient.*

The patient in shock should be treated for the shock, and all unnecessary handling, such as for x-ray pictures, should be avoided. Also diagnostic lumbar puncture is not only dangerous, but also useless.

Rest and carefully balanced dehydration afford the best means of controlling acute intracranial pressure. The routine use of lumbar puncture as ordinarily performed should be discarded. It is rarely indicated, and should be performed with the utmost caution. Subtemporal decompression is not adequate for the control of acute general intracranial pressure and rarely, if ever, is indicated. Trephine with ventricular puncture seems a preferable procedure in the desperate cases where medullary compensation is broken.

By keeping the brain injury patient in bed longer, and by restricting the mental and physical activities for a longer period of time, many of the sequelae may be avoided. Except for traumatic psychosis, many of the remaining sequelae to brain injury may be amenable to surgical relief.

* MCKINNEY, THOS. D., M.D., in *J. Tennessee M.A.*, XXVIII; 449-453, November, 1935.

Lead Poisoning

LIND reports two cases* of acute intoxication after intake of 14 teaspoonfuls of lead oxide during the course of six weeks and of one teaspoonful, respectively, and four cases of occupational lead poisoning after exposure to the effect of lead for six months, four months and five months, respectively. He says that the first two cases, in each of which the characteristic changes in the red blood picture were marked, illustrate the difference in tolerance of lead, the patient who had taken only one teaspoonful being more gravely affected. In one of the five cases with lead colic there was colic-like pain; in the other four the abdominal pain was constant. The lead line appeared in five; the sixth patient was toothless. The author emphasizes that anemia in occupational lead poisoning is a constant and early symptom. A slight increase in the number of reticulocytes and the appearance of basophil punctate erthyrocytes in abnormal number go hand in hand in lead poisoning, being regeneration symptoms. The number of reticulocytes and basophil punctate erythrocytes is on the whole proportional to the degree of anemia. The effects of the blood poisoning have not been overcome until the anemia disappears, the reticulocytes return to normal and the basophil punctate erythrocytes disappear or decrease; resumption of dangerous occupations with lead should not be permissible until this time. Examination of the white blood picture showed no characteristic changes. Lind says that his sixth case of anemia, without signs of active blood regeneration, is one of the rare exceptions to the rule.

* *Hospitalstidende*, Copenhagen, 78:1043, October 1, 1935; Abstr. *J.A.M.A.*, 105:2194, December 28, 1935.

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